MINING CONGRESS JOURNAL

AMERICAN MINING CONGRESS

AMC

NOVEMBER 1959

DENVER agitator type COAL FILTER

Modern Filters NEED Agitation

Now...up to 160□' per Disc...plus

Use the new space-saving filter that's specially designed to dewater coal fines or refuse...that gives exceptionally high, continuous filtration capacity in minimum floor space. Besides higher output with drier cake, you make these important savings: Lower initial cost, lower power consumption, lower maintenance cost.

Submit Details of Your Dewatering Problem

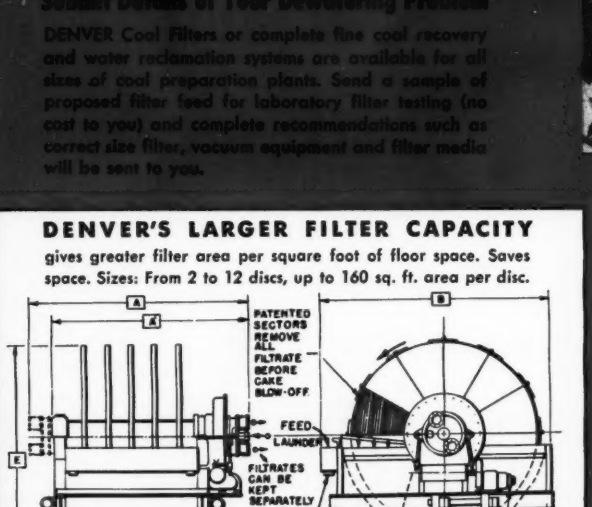
DENVER Coal Filters or complete fine coal recovery and water reclamation systems are available for all sizes of coal preparation plants. Send a sample of proposed filter feed for laboratory filter testing (no cost to you) and complete recommendations such as correct size filter, vacuum equipment and filter media will be sent to you.

THICK, EVEN FILTER CAKE like this

Tank agitation makes this possible

DENVER'S LARGER FILTER CAPACITY

gives greater filter area per square foot of floor space. Saves space. Sizes: From 2 to 12 discs, up to 160 sq. ft. area per disc.



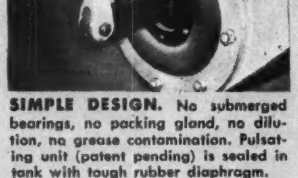
(PAT. PENDING)

SIZE	AREA PER DISC	A 2-DISC	A 4-DISC	A 6-DISC	A 8-DISC	A 10-DISC	A 12-DISC	B	E	HORSEPOWER FILTER	HORSEPOWER AGITATOR
#75	75 sq ft	5'-0"	7'-4"	9'-8"	13"-4"	15'-8"	18'-0"	9'-2"	9'-8"	1-2	1-3
#160	160 sq ft	6'-11½"	9'-7⅞"	12'-3⅜"	16'-3¾"	18'-11¼"	21'-7⅛"	12'-11"	13'-8"	½-5	½-7½

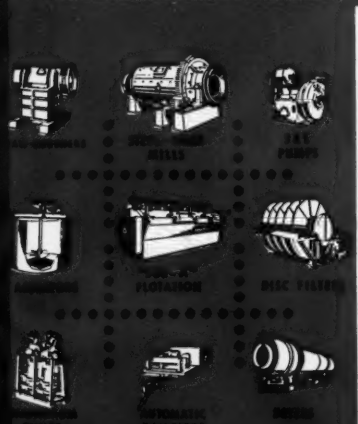
SIMPLE. Agitation in the DENVER Filter is upwards from the bottom, keeps solids in suspension. Entire tank is active. Gives uniform cake distribution for greater filter and vacuum efficiency as well as a drier cake.

SIMPLE DESIGN. No submerged bearings, no packing gland, no dilution, no grease contamination. Pulsating unit (patent pending) is sealed in tank with tough rubber diaphragm.

PATENTED GRAVITY DRAINAGE removes residual moisture from filter sector. Prevents blow-back, gives drier product. Vacuum is applied longer—both after and before cake discharge.



VARIABLE SPEED drive gives flexibility in agitation speed and disc speed. Filter speed is easily adjusted to suit your requirements.



"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEERING STANDARD RELIABLE 24 HOUR SERVICE EFFICIENT

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MINING CONGRESS JOURNAL

VOL. 45 NOVEMBER 1959 NO. 11

Indexed regularly by Engineering Index, Inc.

CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

DEPARTMENTS

ON OUR COVER

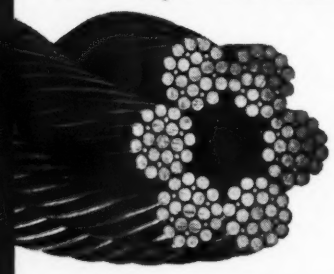
Loading iron ore at the Pickands Mather-operated Mahoning pit, a large and notably successful operation on the Mesabi Range. Total shipments in the mine's 65-year history exceed 115,000,000 long tons.

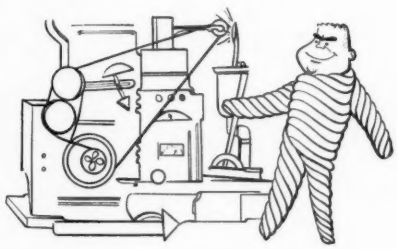
Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, $3.00. Foreign, $10.00. Single copies, $0.75. February Annual Review Issue, $1.25. Second class postage paid at Washington, D. C., and at additional Post Office, Lancaster, Pennsylvania.

Tuffy® Wire Rope Tips

To Get The Most
for What You Pay
Be Sure You Get
Correct Rope Lay

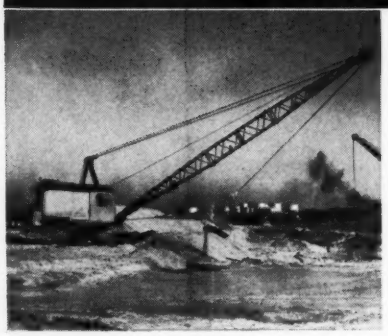
Wire Rope is a "Machine" of Moving Parts





...and Every Part Must Fight Destructive Forces

A "look inside" a piece of wire rope reveals a precision-designed assembly of working parts. The parts are core, wire and strand. They are subjected not only to external and internal stresses and strains, but also to heavy surface pressures and abrasions. All these forces may be sustained while the rope is running under very high speeds, and abruptly changing direction of motion. That's why different uses require different constructions of wire rope.



Tuffy Balanced Dragline Rope

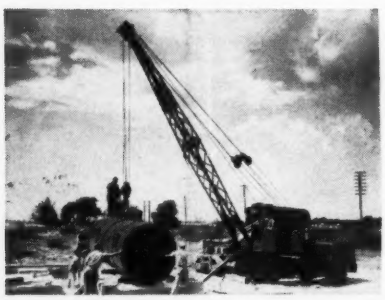
Here's highest abrasive resistance with super flexibility. Better spooling. Smoother riding on grooves. And Tuffy Dragline Rope hugs the drum when casting for full load. Gives you longer service life, consistent dependability, in handling any material — wet or dry dirt, sand, gravel, rock, cement or minerals.

Extra Strength Alone is Not Enough... Wire Rope Must Be BALANCED

Sometimes extra strength is heavily stressed in advertising wire rope. While strength is important wherever wire rope is used, it is not the only important property. And there are cases where too much strength is a liability.

For example, manufacturers of scrapers have designed their equipment to take certain loads. These loads are controlled by, or subject to the ultimate strength of the rope. Larger ropes with higher strength do not break, but *the equipment itself begins to break up.*

Depending on your use of wire rope, the "job prescribed" Tuffy Special Purpose Ropes give you the RIGHT BALANCE of strength, toughness, flexibility for greatest efficiency and longest service life.



Tuffy Balanced Slings & Hoist Lines

"Balanced" because they combine strength, flexibility and toughness in the proper relationship to do a better job longer.

Tuffy Slings and Hoist Lines are a top-performing team in every type of materials handling. The slings are made of a patented, machine-braided fabric that's next to impossible to knot or kink. The hoist lines are a special construction in which strength, flexibility and toughness are balanced.

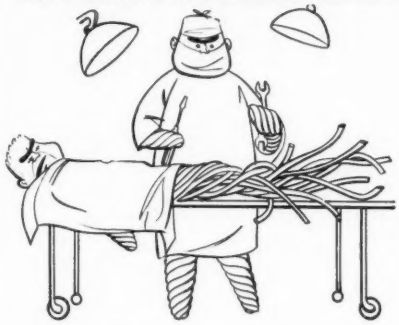
Tuffy Balanced Dozer Rope

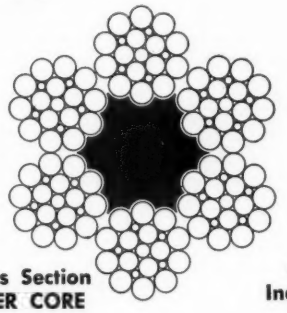
Built to give you longer service with less downtime. Mounted on your dozer, a 150' reel of ½" or 9/16" can give you a big bonus of extra service. Here's how: when rope shows drum wear or is crushed on the drum, you feed through just enough to replace the damaged part. You save the 40 to 50 feet ordinarily thrown away. Also available in 300' and 500' reels.

Tuffy Balanced Scraper Rope

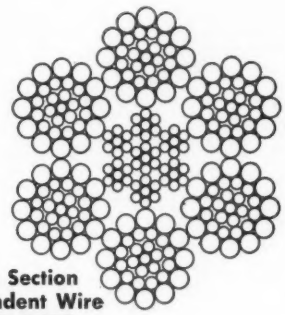
"Balanced" construction makes it flexible enough to withstand sharp bends, yet stiff enough to resist looping and kinking when slack. Also gives higher resistance to the shock of load impact on slack line. Moves more yardage per foot because it's specially built to take the beating of drum-crushing abuse.

Let's Take A Look at the CORE of Wire Rope





Cross Section
FIBER CORE

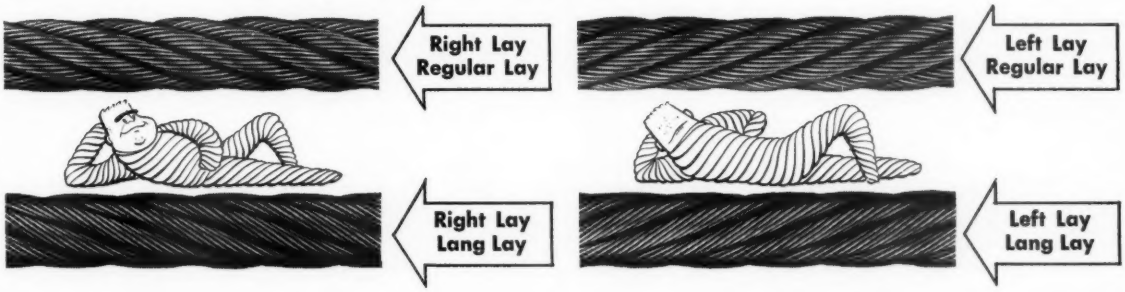


Cross Section
Independent Wire
ROPE CORE

It's either fiber or steel. Fiber cores are usually made from sisal, java, manila or combination of such hard fibers. Steel cores are either wire strand or an independent wire rope core, which amounts to a separate wire rope. The core serves as a base for the strands, keeping the rope in round shape and providing clearance between the strands for freedom of movement.

It's easy to see why wire rope is a "machine"—deserving the same care in selection and use that is given to any fine machine.

Which Lay of Wire Rope is Right for What Use



The "lay" of a rope is described in directional terms. It's a **right lay** when the strands pass from **left** to right across the rope. It's **left lay** when they pass from right to left.

Wire rope is also either **regular** or **lang** lay. In the **regular lay** the wires are laid in strands opposite in direction to the lay of the strands. In the **lang lay** rope, the wires are laid in the strands in the same direction as the lay of the strands.

Most wire rope is regular lay. It has the greatest stability under the widest range of uses. On the other hand, lang lay is used in applications where greater flexibility and longer wearing services are needed.

FREE!

Complete Splicing and Socketing Manual with engineer's notebook on wire rope constructions and specifications. Write for your copy now. Address Union Wire Rope Corporation, 214 Manchester Ave., Kansas City 26, Missouri.

Specialists in high carbon wire, wire rope, braided wire fabric, stress-relieved wire and strand.

Good Man to Know: Your Nearby Union Wire Rope Distributor

Whether your wire rope need is a scheduled replacement or a red-hot emergency, your Union Wire Rope distributor is ready. He keeps varied stocks of Union standard constructions and the Tuffy Special Purpose Ropes. And he's backed by quick service from his nearby Union Wire Rope depot.

If it isn't rope you need, but advice on a wire rope problem, he's just as ready to help. If you don't know your Union Wire Rope distributor already, look under "Wire Ropes" or "Slings" in your telephone directory yellow pages.

Your Tuffy Distributor Can Help You Get Longest Service Life and Cut Rope Costs

UNION Wire Rope

New steels are born at Armco

Subsidiary of ARMCO STEEL CORPORATION

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Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Southwest Steel Products

4

Designed for High Production . . .

Low Maintenance

the JOY 14BU-

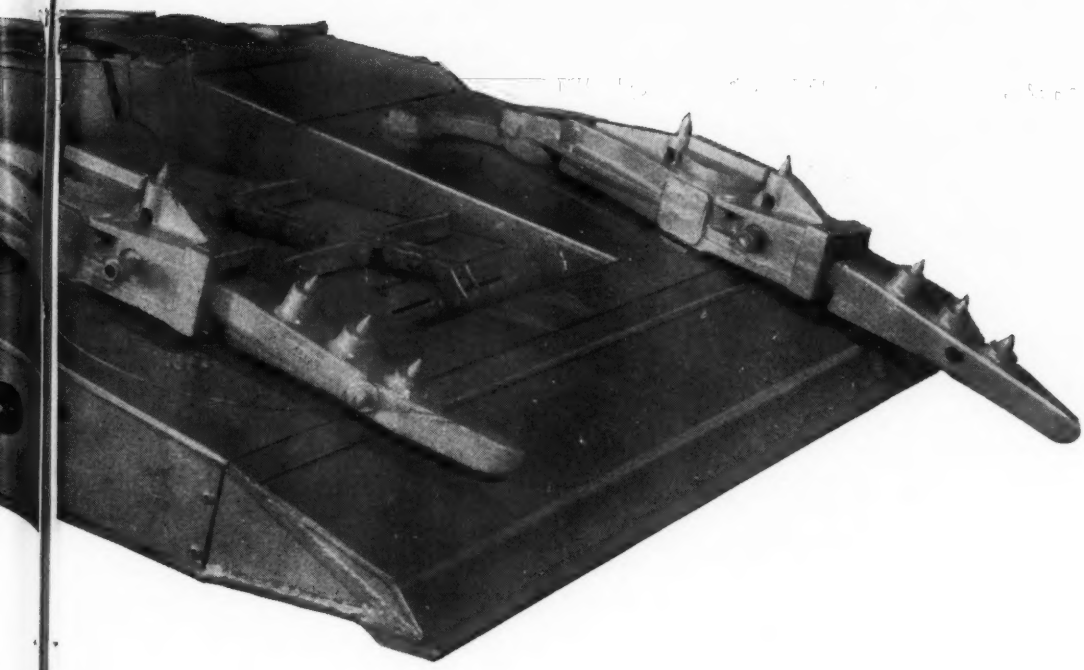
24" HIGH—LOADS 15 TONS PER MINUTE . . . the Joy 14BU-10 is only 24" high . . . yet it has the efficiency and power of a high machine. This tremendous capacity for its size is the result of a completely new design.

The 14BU-10 loads faster because the loading head is 90" wide. This means fewer passes to clean up. The conveyor is 30" wide with a pan line just 14" from the floor—the lowest in the industry. This means room to carry out large lumps in the lowest seams.

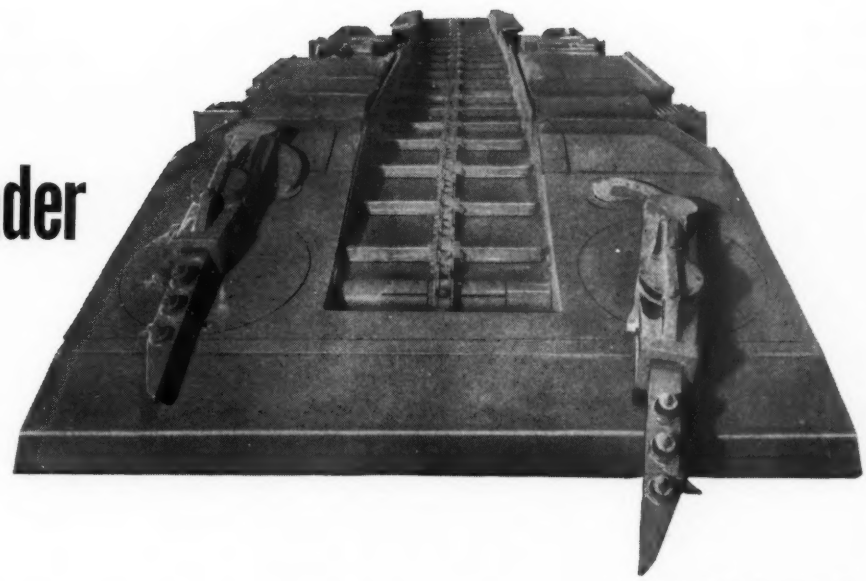
Like larger Joy loaders, the 14BU-10 is designed for low maintenance and is mechanically simple. It has no shifting clutches. All motors and parts requiring maintenance or inspection are mounted outside the frame for easy access and maintenance.

If you operate in a 28" to 34" seam, find out more about the new 14BU-10, the loader really designed for low seams. It can change your profit picture.

335-593



10 loader



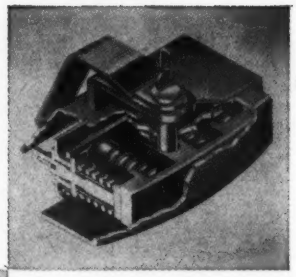
WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING MACHINERY

JOY

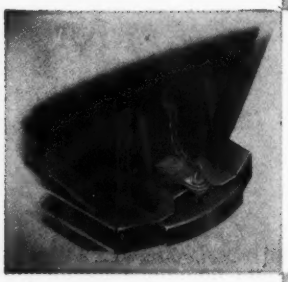
Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

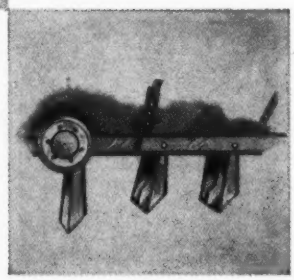
Coal Drills	Coal Loaders	Coal Cutters	Shuttle Cars	Continuous Miners



acf DOUBLE-ACTION SPRING BUMPER



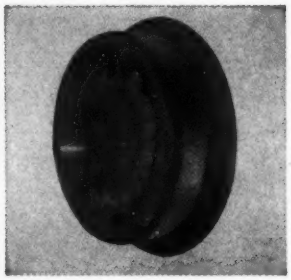
acf WELDED END SILL MEMBER



acf LUBRICATED DROP-BOTTOM DOORS

acf EXTRA-PERFORMANCE COMPONENTS
increase haulage efficiency

acf
LOAD SUPPORT WHEELS



Every acf Constant Haulage Mine Car—drop-bottom, end dump, or rotary dump—pays off in extra productivity, lower maintenance costs. No matter what type or size your operations need, from 20 to 30 tons or more, there's a service-proved acf design that's right for the job. Why not discuss your haulage problems with an experienced acf representative. Just contact the nearest acf sales office or write department MC-10.

Write for this bulletin describing all types of acf *Mine Cars available on request.*

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AMERICAN CAR AND FOUNDRY
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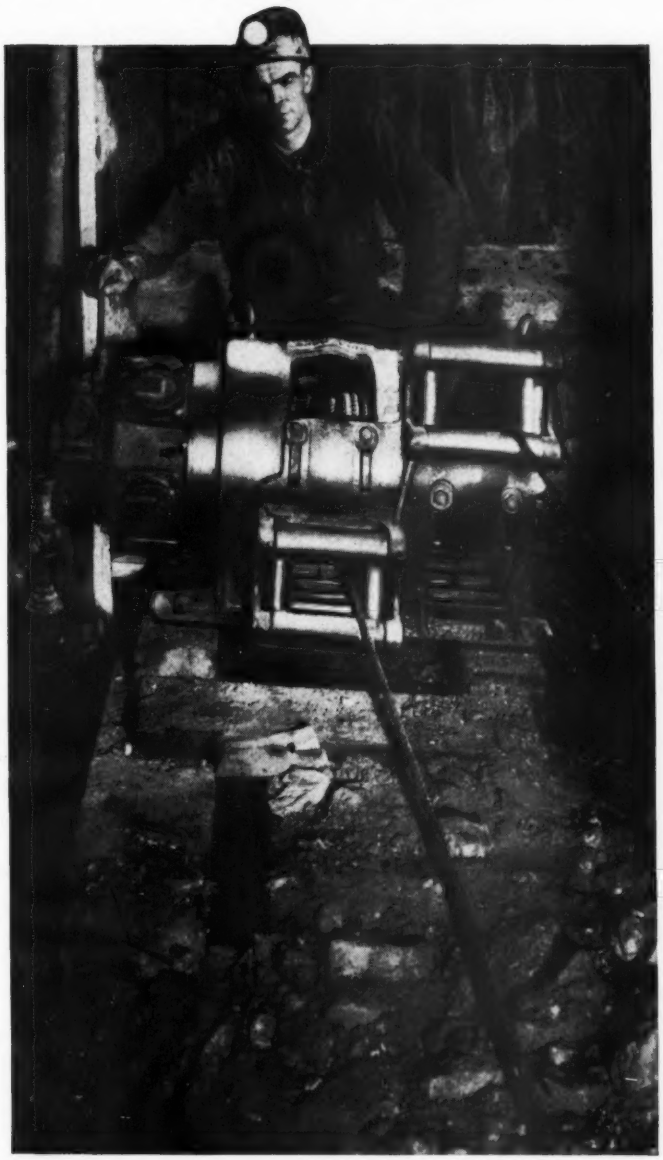
MINE CARS FOR CONSTANT HAULAGE.

SALES OFFICES: New York • Chicago • Cleveland • Washington, D. C. • Philadelphia • San Francisco • St. Louis • Berwick, Pa. • Huntington, W. Va.

MOVE MORE ORE WITH GARDNER-DENVER "AIRSLUSHERS"

. . . power for a full scraper every trip

. . . speed for faster round trips

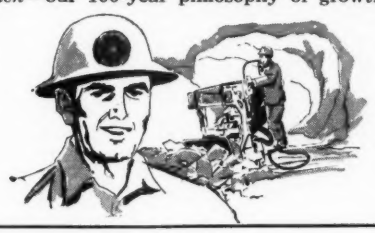


Plenty of slushing power—high-torque, 5-cylinder radial air motor provides digging and tugging power to fill scraper on every pass.
Easy to operate—single lever controls power in either direction. When lever is released, air motor stops—does not waste air idling.
Stays underground—air motor and drive are completely enclosed to keep water and dirt out . . . oil in. Parts are designed to deliver maximum service with little maintenance.
No clutch facings to wear—simple roller clutch automatically and instantaneously engages one drum and releases the other as throttle is reversed.
Only three points to oil—air motor, gear train and throttle valve.

Move more muck with the finest of slusher hoists—Gardner-Denver "Airslushers." Write for details.

CALL THE GARDNER-DENVER MAN

Your Gardner-Denver mining equipment specialist is trained to assist in drilling and mucking problems . . . to help keep your Gardner-Denver equipment in tiptop shape. At Gardner-Denver *there's no substitute for men*—our 100-year philosophy of growth.



GARDNER-DENVER Since 1859 100 1959 YEARS

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
Export Division, 233 Broadway, New York 7, New York
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

"Spotty, as a digger, you just ain't got it!"

Without realizing it, Billy has hit upon a basic truth in the excavating business. To come out on top, you've got to use the best equipment for the job.

With many factors beyond a contractor's control, choosing the right equipment becomes especially important. For this is one thing a man *can* control.

That's why so many contractors choose Bucyrus-Erie. They have learned . . . as their fathers did before them . . . that B-E machines are built for more than ordinary digging. They are built to handle the toughest jobs — and still perform better.

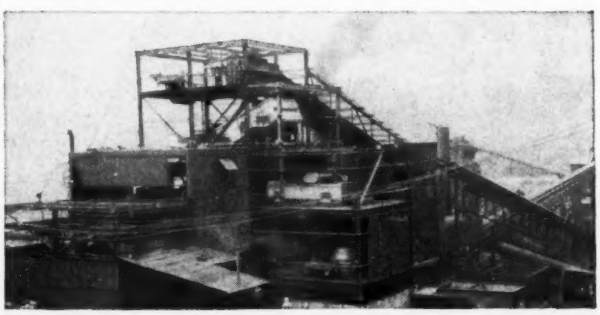
BUCYRUS ERIE

Coal Preparation Plants built in '59

. . . BY HEYL & PATTERSON

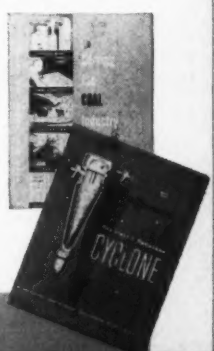
H&P

. . . and now under construction!



1. Westmoreland Coal Co., Hampton No. 4 Preparation and Thermal Drying Plant . . . 440 TPH of 5" x 0 coal.
2. Jewell Ridge Coal Corp., Jewell Valley Preparation and Thermal Drying Plant . . . 160 TPH of ¼" x 0 coal.
3. Rochester & Pittsburgh Coal Co., O'Donnell Mine No. 2 Preparation and Thermal Drying Plant . . . 400 TPH of 5" x 0 coal.
4. Massey Coal Mining Co., Ben Creek No. 2 Preparation Plant . . . 120 TPH of ¼" x 0 coal.

Write for Free Brochures
describing complete Preparation Plants or Processing and Thermal Drying equipment.



HEYL & PATTERSON, inc.

55 FORT PITT BLVD., PITTSBURGH 22, PA.

WHEN EXPERIENCE COUNTS . . . COUNT ON HEYL & PATTERSON!

Proving again and again

LOWEST COST PER TON

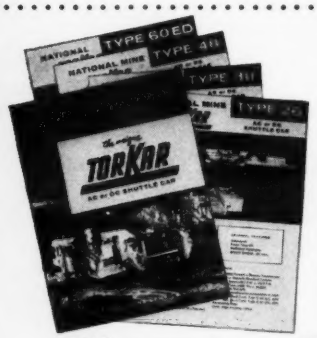
of materials handled

National Mine

TORKARS

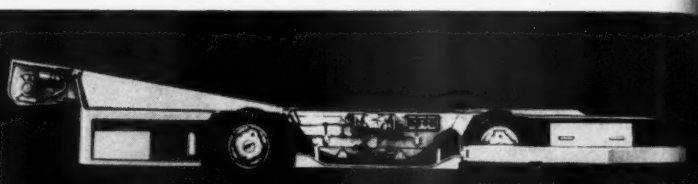
SINGLE PRIME MOVER-TORQUE CONVERTER

Dramatic records for performance and low maintenance are being achieved wherever TorKars are used. TorKars are unique in that they are powered by a single, large capacity motor (or diesel engine) in place of small multi-motors required on conventional shuttle cars. With a torque converter and three-speed forward-and-reverse transmission applying power equally to all four wheels, flexibility of operation is vastly increased, the control system is simplified, service costs are lowered, and high operational standards are maintained.



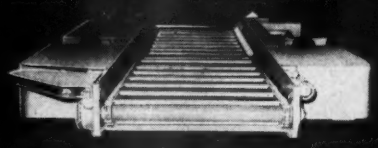
Write *for the informative new TorKar Bulletin and for Specification Sheets on all models.*

The trend is to TorKar



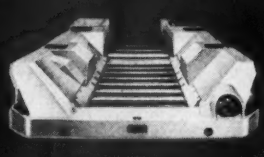
TYPE 26 D.C. or A.C.

Body height 25½", for use in thinnest commercially-workable seams.



TYPE 30 D.C. or A.C.

Heights 30" to 36", capacities from 120 to 167 cubic feet.



TYPE 48 D.C. or A.C.

Heights 40" to 54", capacities 4 to 8 tons (10 tons with sideboards).

TYPE 60 DIESEL

Height 60". Capacity 20 tons. Equipped with patented National Mine Exhaust Gas Conditioner.

National Mine Service Company

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IN CANADA:

NATIONAL MINE SERVICE (CANADA) LIMITED

Elliot Lake, Ontario

Shrink distance...and OVERHEAD

with hustling, go-anywhere tractor

Are you still supporting *part*-time pit workers — 3 or 4 crawler tractors — for maintenance jobs? You're carrying unnecessary overhead if you do. Limited speed and mobility tie crawlers down to a limited working area. Lack of continuous work in those "pockets" often keeps them idle much of the day. Yet the cost of owning and maintaining a fleet of localized dozers is continuous.

It's possible that you may be able to replace those inefficient units with a single tractor... a mobile dozer-*on-rubber* that goes anywhere anytime you have work to be done. The 17-mph, 218-hp LeTourneau-Westinghouse C Tournatractor® is a "hit-and-run" specialist that handles pit housekeeping *just* as efficiently as a fleet of several special-purpose crawlers and can often cut clean-up and other dozing expense by half the present cost or more.

Travels at twice crawler rate

Tournatractor gives you the speed and mobility that pays off in servicing scattered locations. Travel to the next job is at speeds up to 17 mph — twice as fast as that of most crawler-mounted dozers.

Speed ranges, 4 forward, 2 reverse, are selected by simple hand lever. Within ranges, torque converter automatically adjusts power to load. Blade movement is accurately controlled electrically, through fingertip dashboard switches.

Check your multiple tractor operations for productive hours of operation. If travel and waiting time figures 30% or more be sure to ask for a Tournatractor demonstration.

Stripping dirt and clay overburden is just one of many jobs C Tournatractor takes in stride for Millbrook Quarries, Inc., Broad Run, Va. Handy "hit-and-run" dozer also cleans up pit after blasting, shapes limestone stockpiles, cleans around crusher, and tows equipment. Output averages 1,000 tons per day.

"If I could get a hold on it, I could move a mountain with this Tournatractor," says Operator Claude Wampler at Millbrook Quarries. "This dozer's got plenty of power and speed, doesn't take all day to get to a job. It's easy to throttle down from high travel-speed."

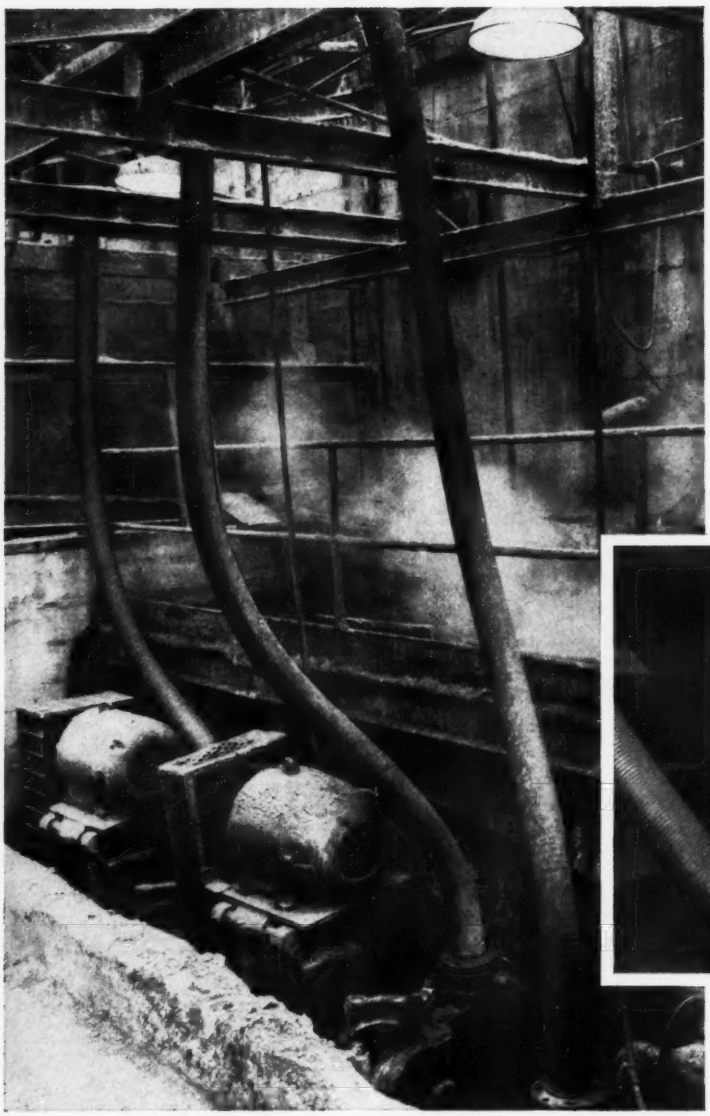
CT-2027-MQJ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

US RUBBER PILOT PIPE



Abrasion in piping?

Here's how a big uranium mill solved it with "U.S." flexible rubber pipe

• Four 8" U. S. Pilot Pipes carry fine screened ore from secondary crusher storage bins. Four more pipes feed too-coarsely crushed aggregate onto a conveyor belt and back into the crusher. On both jobs, Pilot Pipe has lasted over 4 years.

• In this severe service, quenched calcined ore pulp —50% solid—is pumped through these lengths of U. S. Pilot Pipe, from the roaster calcine pumps.

Where to get flexible piping that can stand up to severe abrasion without being chewed up?

Union Carbide's Uravan mill found the answer in U. S. Pilot® Pipe and Pinch Valves. In addition to the operations pictured above, these products handle the slurry on the 9 separate pumping stations of the counter-current decantation wash circuit, are used on the 2 booster stations between leach and tailings disposal plants and between the primary acid leach and roaster.

This pipe is specially built to handle abrasive materials, such as calcined ore, *and corrosive* materials, such as solutions containing sulfuric and hydrochloric acids. It is flexible, easy to install and won't build up. Its service life is longer than that of metal pipe.

• • •

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

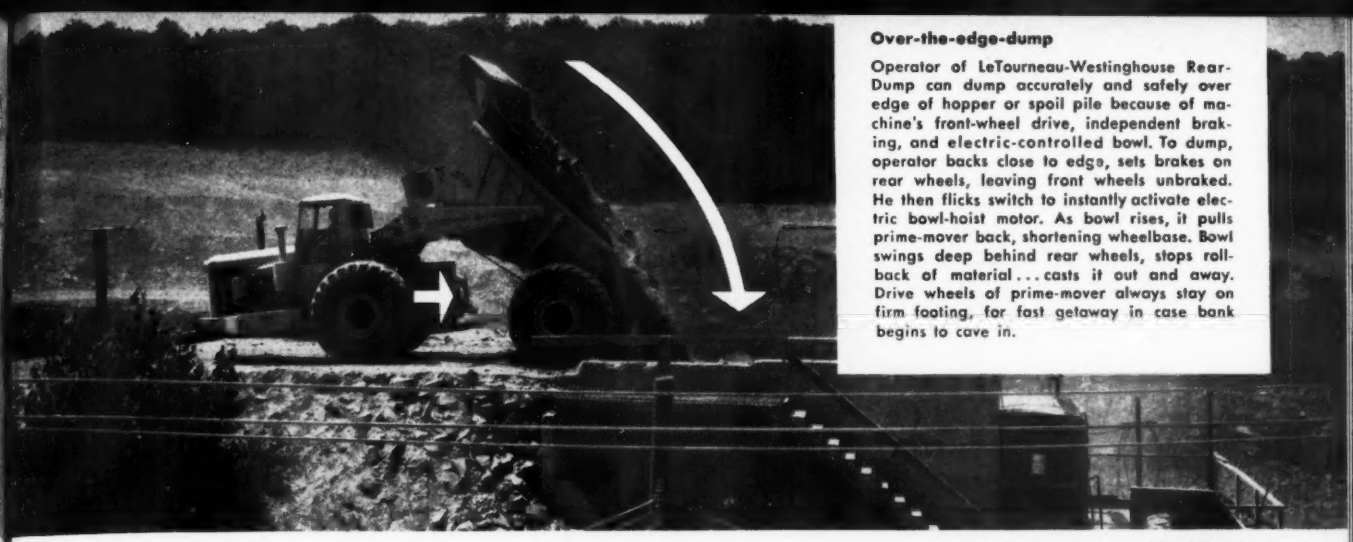
US RUBBER

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

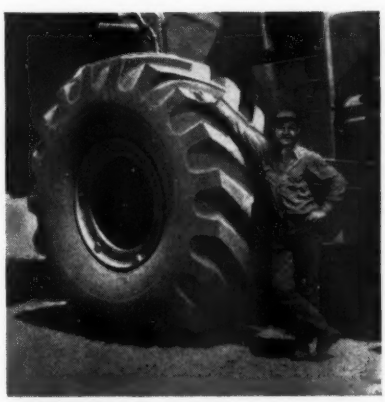


Over-the-edge-dump

Operator of LeTourneau-Westinghouse Rear-Dump can dump accurately and safely over edge of hopper or spoil pile because of machine's front-wheel drive, independent braking, and electric-controlled bowl. To dump, operator backs close to edge, sets brakes on rear wheels, leaving front wheels unbraked. He then flicks switch to instantly activate electric bowl-hoist motor. As bowl rises, it pulls prime-mover back, shortening wheelbase. Bowl swings deep behind rear wheels, stops roll-back of material . . . casts it out and away. Drive wheels of prime-mover always stay on firm footing, for fast getaway in case bank begins to cave in.

COMPARE

- **capabilities of your present haulers**
- **advantages of L-W Rear-Dumps**



Hauls through soft, slippery areas

L-W Rear-Dumps haul safely through areas where other units bog down. Here's why: (1) Exclusive power-transfer differential, automatically transfers power from a slipping drive wheel to wheel on better footing. (2) 90° kingpin electric steer . . . independent of drive train . . . helps you "duck walk" out of trouble. Operator just turns prime-mover left, right, left, etc., to swing drive wheels ahead until they "walk" out and reach solid footing. (3) Rear-Dump can be "humped" forward, when bowl is empty, to get out of soft areas. Bowl is raised with front brakes locked and rear brakes released, shortening wheelbase . . . then bowl is lowered with rear brakes held and front released. Thus, without use of drive wheels, Rear-Dump "humps" forward.

No-drag "skid bottom" construction

There are no springs, hangers, tie-rods cluttering up the bottom of your L-W Rear-Dump. Simple "skid bottom" construction eliminates drag over dirt and rocks. Bowl is hitched to prime-mover through a horizontal yoke extending back from kingpin, and pivoted to body itself . . . just above and ahead of rear wheels. There is no frame or sub-frame to get out of alignment. Front-wheel drive and kingpin steer eliminate long drive shaft, hinged steering connections.

Big target for fast, easy loading

L-W Rear-Dumps' big, wide, unobstructed top makes an easy target for your shovel operators. Low, wide rear entry of this hauler lets dipper swing in smoothly, quickly . . . in one continuous arc . . . rather than the up-over-in, up-over-out motions needed with high-top trucks.

Big, single tires absorb shock, eliminate trouble of duals

4 giant, low-pressure tires dissipate vibrations and stress of high-speed hauls . . . absorb shock of heavy loads dropped into bowl. They flex and roll easily over rocks that might bruise or break smaller duals. There is no divided face where wedged-in rock fragments can wear and tear.

Write or phone your local L-W Distributor for more information on these big-production, low-cost Rear-Dumps. They are available in 11, 22, and 35-ton sizes.

R-1871-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Questions

We've been asked about the Yieldable Arch

"How do you determine the spacing between Yieldable Arch sets?"

In general, Yieldable Arch sets are spaced 3 to 4 feet apart, though we know of installations where spacing ranges up to 6 feet. The important thing, always, is to space the sets closely enough so that the Arches and not the lagging will do the yielding. As a rule, the softer and heavier the ground, the closer the spacing.

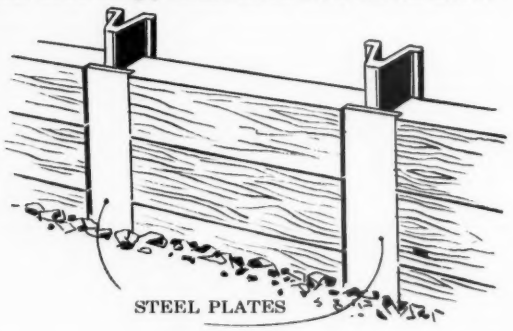
For lateral stability, each Yieldable Arch set should be tied to its neighboring set with channel struts and J-bolt clamps furnished by Bethlehem especially for this purpose. This strutting is usually installed at five points along the periphery of the Arch.

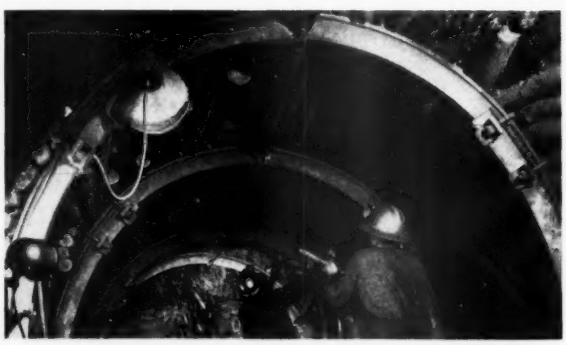
SEND US YOUR QUESTIONS

You probably have other questions of a specific nature, concerning the application of the Yieldable Arch or Ring to your mine. If so, by all means send them in; we will study your problem and reply as promptly as possible. Write Room 1041, at the address below.

"What method can you suggest to prevent scrapers from catching on the legs of Arches?"

A Michigan mine solved this problem by welding plates —about ½ in. x 5 in. x 24 in.—to the exposed edge of the legs, and then placing 4 in. x 6 in. timbers behind the plates. The timbers were notched so that the steel plates fitted snugly inside them. Note sketch below.





"Is the Yieldable Arch easily adaptable to such techniques as spiling and forepoling?"

Yes. And many mines right now are using their Arch sets in conjunction with these mining techniques.

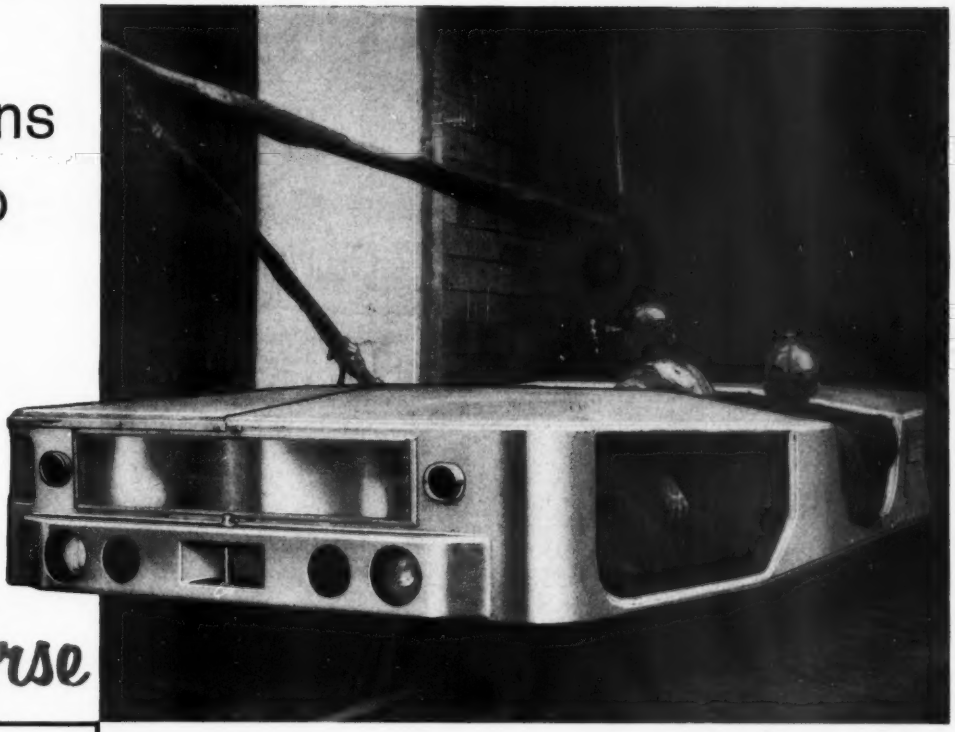
In some upper Michigan mines, pipe spiling is used to protect the men at the face. Above the top blast holes, and angled slightly upwards, 4 to 8 holes 1½ in. in diameter are drilled 10 ft deep. One-inch pipes are inserted over the tops of the arch sets at the face, and the round is blasted. Pipes give support during mucking out, until next steel set can be placed (see photo above).

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Reasons why so many mines use the Lee-Norse LOW mine portal bus



(1) FAST—Cuts portal to portal time as much as 50%.

(2) STREAMLINED—Transports 11 to 13 men in safety and comfort in low seams.

(3) SAFETY—Exclusive split-roof allows operator full directional vision—trolley pole easily reached. Quick acting hydraulic truck-type brakes on each axle and on the traction gearmotor. Independent mechanical hand parking brake each axle.

(4) POWERFUL—Self-propelled by sturdy traction-type 15 HP gearmotor (250 or 550V—DC).

(5) RUGGED—Quality built to withstand the hard usage of 'round the clock mining!

(6) LOW MAINTENANCE—Simple design—easy accessibility.

(7) OPTIONAL FEATURE—Electric dynamic brakes for plus safety on severe grades.

LN

Lee-Norse Company

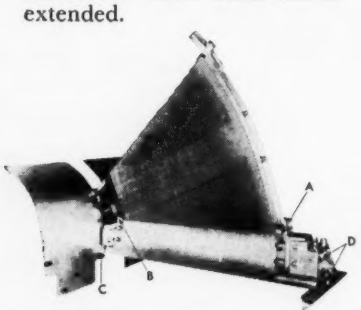
CHARLEROI, PENNSYLVANIA

Specialists in Coal Mining Equipment

New Scraper For Coal Filters

"Dual Guide" Scrapers* completely discharge even thin filter cake without tearing wire cloth . . .

Designed for wire cloth filters, "Dual Guide" Scrapers form a close but positive clearance between the scraper edge and the wire cloth. Filter cake is prevented from by-passing the scraper to be refiltered . . . yet, sufficient clearance is maintained to prevent tearing of wire cloth. Filter capacity is increased. Wire cloth life is extended.



How Peterson's New "Dual Guide" Scrapers Work:

Guides are provided both on the rim of the disc (A) and at the heel of the scraper (B). A perfect parallel is formed and maintained between the blades by means of a pin or hinge mounting in the rear of the scraper (C), and a bar hinge in the front (D). As the scraper moves to follow any misalignment of the disc, parallel clearance on both sides of the disc is maintained exactly as originally set.

"Dual Guide" Scrapers can be made to fit any type disc filter. Write for data on DG-104.

*patented

Look for filter parts with the Viking Mark

PETERSON FILTERS
AND ENGINEERING COMPANY
P. O. BOX 606 • SALT LAKE CITY 10, UTAH

VICTAULIC®

METHOD OF PIPING

VICTAULIC HAS EVERYTHING . . .

VICTAULIC COUPLINGS
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".

ROUST-A-BOUT COUPLINGS
For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB

VICTAULIC FULL-FLOW FITTINGS
Elbows, Tees, Reducers, Laterals, a *complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".

VIC-GROOVER TOOLS
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. 57

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

REDUCE PER-TON COSTS
in stripping operations

HENDRIX
Heavy Duty **Mining Buckets**

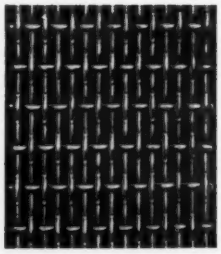
Increased bucket width, higher arch, tapered basket, arched lip and extra strength throughout provide unsurpassed digging, loading and dumping . . . assuring greater production at a lower cost-per-ton.

4½ to 14 Cubic Yards With or Without Perforations

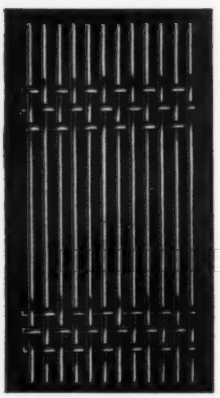
Hendrix DRAGLINE BUCKETS

HENDRIX MANUFACTURING CO., Inc.
MANSFIELD, LOUISIANA

When you order screens, be sure to specify the type which best meets your requirements. For example:



For maximum through capacity, CF&I Space Screens with rectangular openings are recommended. The high percentage of open area provides considerable freedom from blinding or clogging.



For maximum freedom from blinding or clogging, CF&I Long Slot Space Screens are the most efficient construction. Because of the open area and intense vibration of wires on the long sides of the openings, material can not cling or build up.

* * *

Whatever your screening operation, our engineers will be glad to help you select the optimum screen for your needs.

The Image of CF&I offers

SPACE SCREENS

for less downtime . . . long screen life . . . accurate screening

Symbol for the dependability of all CF&I steel products, the giant steelman can be relied on for tough, precision space screens.

CF&I Space Screens are ideal for rugged screening operations because they are made from quality steel, and are available in a wide selection of types, weaves, crimps and edge preparations. They give long service and, consequently, fewer work stoppages and greater tonnage output for your screen dollars. CF&I Space Screens are tightly woven to retain uniform spacing and openings, thus assuring accuracy under the most demanding screening conditions.

For engineering assistance in choosing the right space screen for your operation, contact our nearest sales office.

CF&I SPACE SCREENS

THE COLORADO FUEL AND IRON CORPORATION

CF&I STEEL

In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte Denver • El Paso • Farmington (N. M.) • Ft. Worth • Houston • Lincoln • Los Angeles • Oakland • Oklahoma City Phoenix • Portland • Pueblo • Salt Lake City • San Francisco • San Leandro • Seattle • Spokane • Wichita

In the East: **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans New York • Philadelphia

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CANADIAN REPRESENTATIVES AT: Calgary • Edmonton • Vancouver • Winnipeg 6924-D

KW-DART 40T
450HP — 40 Ton Payload

with TIME and POWER to spare

When the KW-DARTS come roaring out of the pit, there's lots of power left over. Every KW-DART is job engineered — with combinations of components matched to do the job faster and easier. That's why KW-DARTS perform better . . . for lower maintenance costs . . . and for longer service life.

There are KW-DART sales engineers near you who can analyze your specific needs. Your phone call or letter will bring an immediate response.

KW-DART TRUCK CO.

Subsidiary of Pacific Car and Foundry Company

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152

Your new plant or expansion idea

Raw materials available?

Market available?

Location correct?

Capacity adequate?

Readily financed?

Right time to build?

Kaiser Engineers specializes in the design and construction of major facilities used throughout the Minerals industry, and has world-wide experience in design of such facilities.

Among KE's most valued services are sound, searching, economic analyses, feasibility studies and site and market evaluations. In a word—*Pre-Engineering*—impartial, outside analysis which helps you decide whether to proceed with, defer or modify the project.

Kaiser Engineers offers you cost-saving, time-saving one-company service from concept through start-up.

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Division of Henry J. Kaiser Company
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• KE projects include work in Australia, Brazil, Ghana, India, New Zealand, as well as Canada and the United States. Assignments include iron ore concentrating plants, cement plants, bauxite and alumina processing plants and diatomaceous earth facilities.

5459-M

Here's safe, dependable power for Mining—

NEW A-C DIESEL GENERATING SETS WITH BRUSHLESS GENERATORS

. . . offer 5 big advantages

1. Single manufacturer responsibility

Allis-Chalmers manufactures and stands behind all four major components that comprise these *complete* units — the modern diesels, the proved brushless generators, the rapid-response regulators and the switchgear. This means coordinated engineering, matched performance, undivided responsibility — an Allis-Chalmers exclusive.

2. Fast starts — Fuel savings

The modern diesels, with their unique, controlled combustion, start and pick up loads in 4 to 10 seconds. They save fuel, too. The 21000, for instance, saves 8½ to 27% in fuel over other diesels in its class. That's 1 to 2½ gal. of fuel in every 10!

3. Precisely regulated power

The new Allis-Chalmers magnetic amplifier type static voltage regulator has no moving parts or contacts. No parts to burn or wear. It has unequaled fast response to sudden changes in load. Precise power regulation protects sensitive apparatus, easily picks up heavy motor starting loads.

4. Brushless generator has new simplicity

There are no slip rings, no brushes, no commutators to wear or to spark. Newly developed, non-aging silicon rectifiers rotate with the armature and replace the slip rings, brushes and commutator. Brushless generators are ideal for operation in dusty areas or in corrosive or explosive atmosphere — provide unequaled electrical reliability.

5. Fast, easy unit installation

These sets are simple, unit-type, self-contained. They are mounted on husky skids — no special foundation is required, no danger of misalignment. Electrical connections are simplified, to speed installation and reduce related costs.

Your Allis-Chalmers dealer can give you complete specs, and assist in determining your needs. Call him or write Allis-Chalmers, Milwaukee 1, Wisconsin.

BG-36A

ALLIS-CHALMERS

***POWER* FOR A GROWING WORLD**

Whatever the nature of the seam, there's a Cyanamid Permissible to do the job *economically!*

Cyanamid's group of 12 American Permissibles contains a correct grade for every blasting requirement. Our complete line includes a variety of low, medium and fast rate powders with a wide range of densities.

You get dependable shooting with Cyanamid permissibles. Prompt delivery, too, because our network of plants and magazines closely parallels U.S. coal operations.

Our experienced explosive engineers are always ready to advise you in the correct selection of permissibles. Electric Blasting Caps and other blasting accessories are also available for your operation.

Additional information on Cyanamid permissibles is contained in a brochure available on request.

CYANAMID

AMERICAN CYANAMID COMPANY

EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

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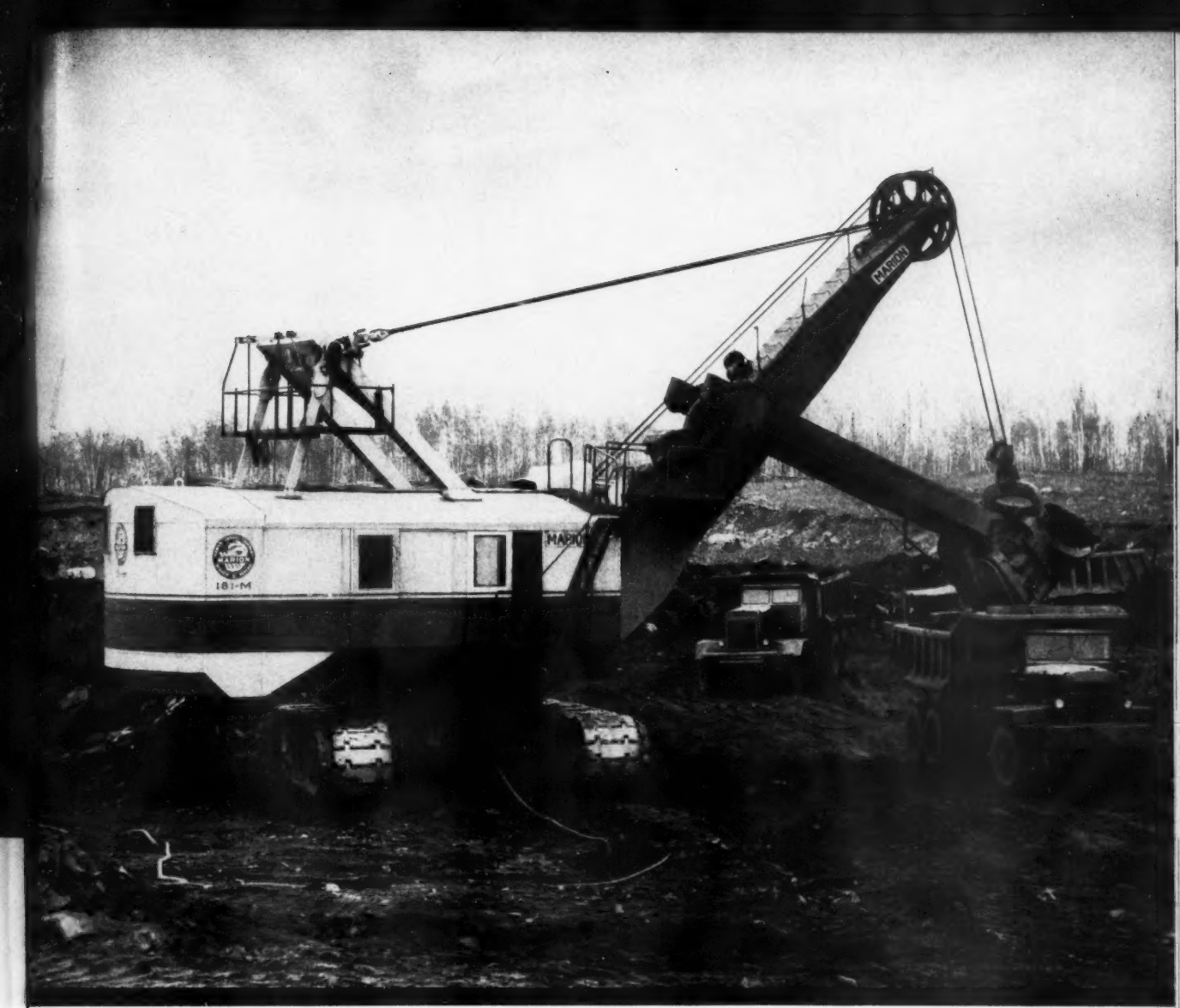
PRODUCTS: High Explosives • Permissibles • Seismograph Explosives • Blasting Agents • Blasting Caps • Electric Blasting Caps • Blasting Accessories



AT HOME ON THE "RANGE"

If there's an 9-yard mining shovel in your future, make it a Marion 181-M.

Here's a husky machine with the traditional strength, power and endurance of Marion mining shovels—plus small machine cycle time for an extra payoff every day.

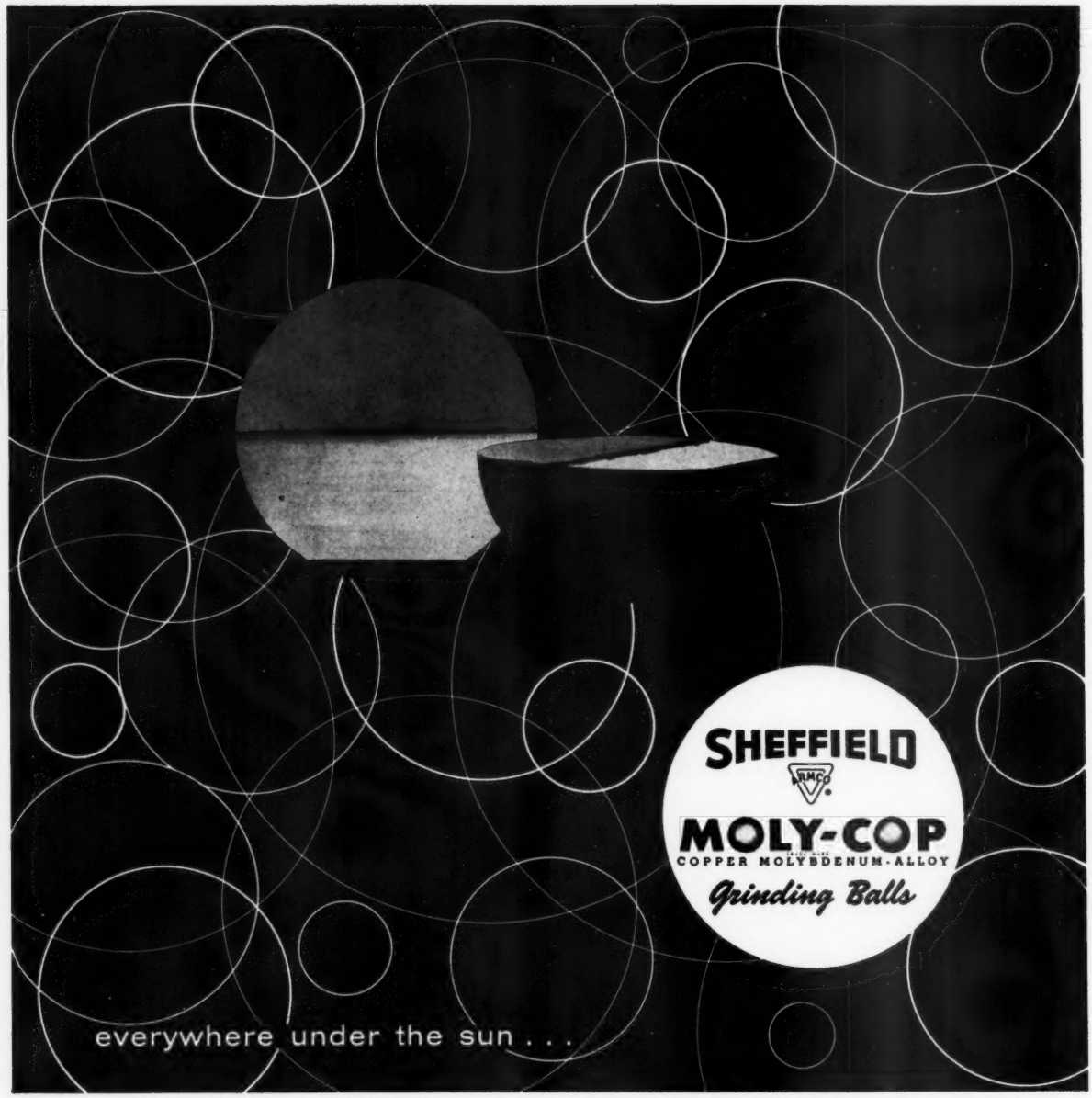
The 181-M has a combination of design, construction and performance features that can lower your costs and add to your profits.

If you haven't seen Bulletin 439 on this 9-yard Marion, write for your copy today.

You get **MORE** *with* **MARION**

MARION POWER SHOVEL COMPANY • Marion, Ohio

A Division of Universal Marion Corporation



The Standard of Comparison for LONGER LASTING ROUNDNESS

Performance tests by mills all over the world show Moly-Cop balls retain their spherical shape longer. That's because the alloying, forging and heat treating techniques used by Sheffield assure uniform quality to the very core of the ball. It means you'll get longer service, less down-time and other important production economies with Moly-Cop balls.

SHEFFIELD DIVISION

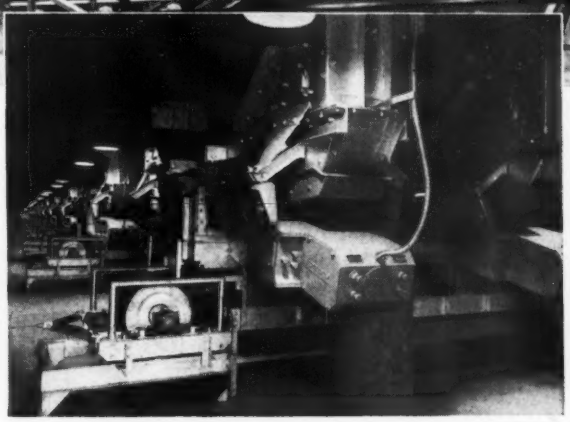
New steels are born at Armco

ARMCO STEEL CORPORATION

OTHER DIVISIONS AND SUBSIDIARIES: Armco Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

Jeffrey magnetic separators help raise iron content of pellets to 64%.

Jeffrey vibrating feeders keep ore on the move.



New Taconite Plant sets 24-hour, year-round pace!

IRON YIELD of the Mesabi Range is being greatly extended by a new plant which can, *every day,* turn about 63,000 long tons of taconite ore into approximately 20,000 tons of pellets bearing up to 64% iron. Efficient, trouble-free Jeffrey equipment is an important part of the vast and highly mechanized operation which makes this processing economically practical.

Jeffrey Magnetic Separators – 216 ball mill roughers and finishing separators are used in concentrator operations. After proper settings are made, feed may vary from zero to maximum capacity without further adjustment. Separators furnished in both permanent and electro types.

Jeffrey Vibrating Feeders – 48 heavy duty 5DTS units feed coarse ore from surge bins to cone crushers and screens. 324 Type 4DTH units feed fine ore to rod mills. 48 Type 4DTS feeders handle hot pellets. Balanced vibration assures quiet operation, definite control, easier installation, low operating and maintenance costs.

In all types of mining and processing of solids, carefully engineered, precision built Jeffrey machinery and components provide long, dependable service. Write for Catalog 910. The Jeffrey Manufacturing Company, 958 North Fourth Street, Columbus 16, Ohio.

EXPORT DIVISION

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

Harmattan Mine coal haulers have been using STANOLUBE HD-M Motor Oil for 10 years --here's why

Pick a spot on the haulage road. Every three minutes one of the Harmattan Mine's ten 40-ton coal haulers passes the spot on the way to the preparation plant. These coal haulers have used STANOLUBE HD-M Motor Oil for ten years for these reasons:

Product: STANOLUBE HD-M Motor Oil is refined from the highest quality base stock. Blended into this carefully refined base oil are additives that retard oxidation, minimize piston ring deposit formation and prevent the forming of excessive varnish and sludge. Other additives prevent corrosion of bearing metals and eliminate bronze wrist-pin bushing corrosion.

Technical Service: Fred Barnes, who has 22 years' experience providing lubrication technical service at Standard Oil, calls on Harmattan Mine. He lives at Decatur, only

Harmattan Mine truck foreman Ralph Westfall and Standard's Fred Barnes inspect coal hauler piston. Prior to his 22 years' service providing technical assistance on lubrication problems, Fred Barnes attended James Millikin University. He has also completed the Standard Oil Sales Engineering School.

80 miles from the mine. Fred is on call at any time to get to the mine and render assistance on any problem involving lubrication engineering.

Deliveries: A Standard Oil agent located only five miles from the mine delivers lubricating oil, is handy for regular deliveries and for special deliveries at a moment's notice. The mine management never needs to worry about inventories of STANOLUBE HD-M. Their Standard Oil agent takes care of that.

Would you like this kind of service for your coal mining equipment? It's at your doorstep anywhere in the 15 Midwest or Rocky Mountain states. Call your nearby Standard Oil office. Or contact by letter, wire or telephone: **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

One of the biggest draglines ever built is this Bucyrus-Erie unit. It is one of two in service at Harmattan Mine. Both are Standard Oil lubricated.

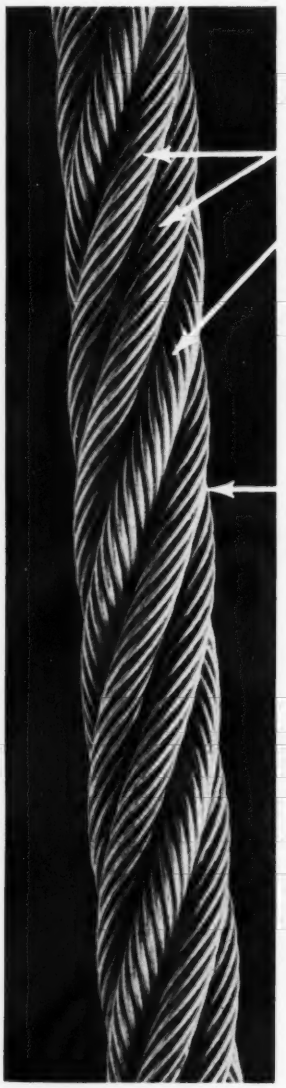
Every three minutes one of these 40-ton coal haulers moves down haulage road to preparation plant. STANOLUBE HD-M Motor Oil stands up to the tough service imposed on it. Dirt, adverse road conditions, hot engine operation and heavy-load—no-load service cannot lick this oil.

Quick facts about

STANOLUBE HD-M Motor Oil

- Refined from highest-quality base stock.
- Contains special additives that prevent bearing and bronze wrist-pin bushing corrosion, reduce piston ring varnish and keep rings free to seal against blow-by.
- Contains still other additives that reduce wear on heavily stressed parts.

You expect more from **STANDARD** *and you get it!*



Herringbone's two pairs of Lang lay strands and one pair of regular lay strands provide the ideal combination of maximum flexibility with good stability.

Finer wires inside contribute to Herringbone's excellent drum-winding characteristics.

Heavier outside wires in each strand have greater resistance to abrasion.

"Herringbone* saves our equipment"

AMICO SAND AND GRAVEL COMPANY

Read this about the most exciting wire rope development in years . . . "Turning a profit on any product often boils down to something that will do a specific job better than anything else. Our equipment operators prefer Roebling Herringbone to any other for heavy lifts, clam shell, drag, pan work or dozers. The savings on sheaves, because of Herringbone's perfect tracking, are a big item as far as we are concerned."

Amico Sand and Gravel Company, Morrisville, Pennsylvania, and Riverside, New Jersey, has told you what this combined regular lay and Lang lay rope—two-ropes-in-one—is doing for them. Roebling is in a position to *show* you how the new Herringbone can, again, in the words of Amico ". . . give you a chance to turn more profit on production equipment." Write to Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey, for the full and fabulous facts.

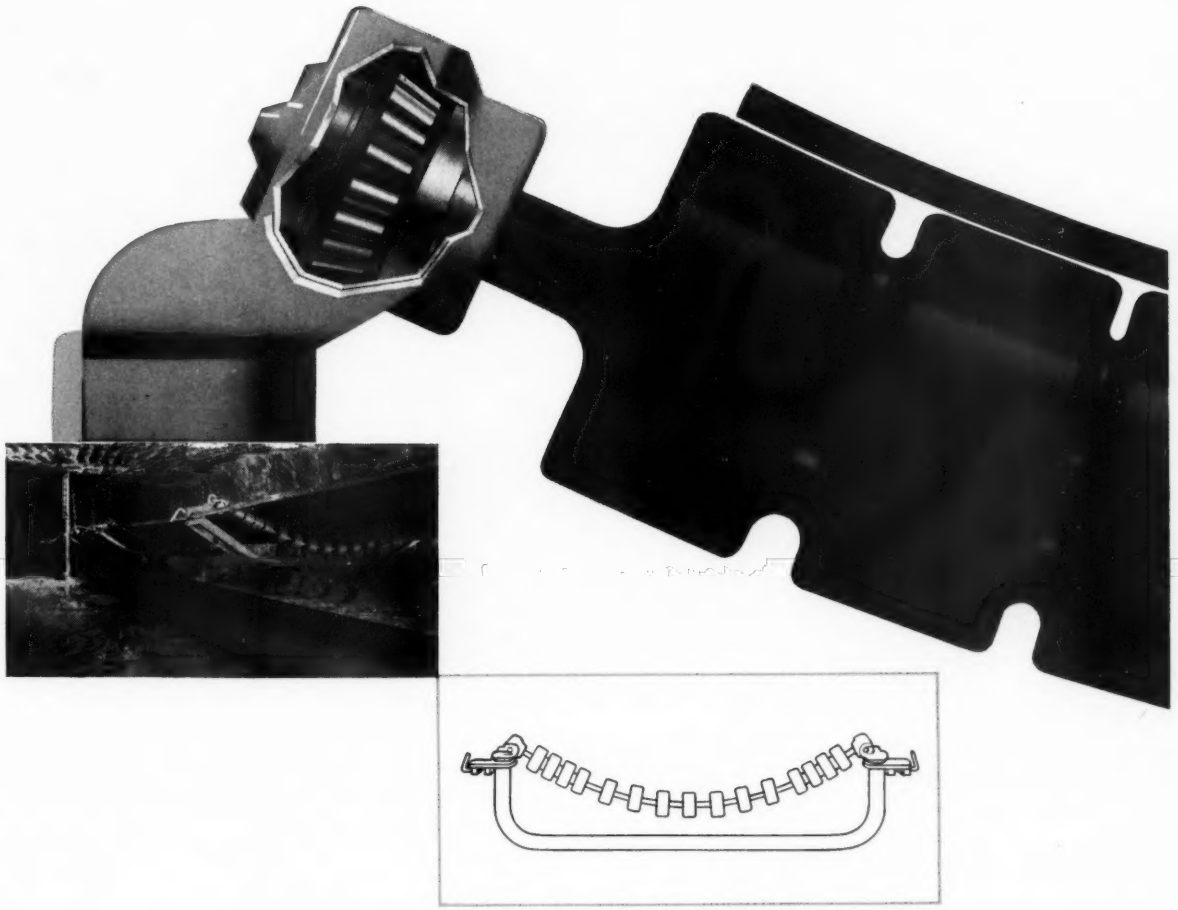
*Reg. App. For

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

ROEBLING
HERRINGBONE
WIRE ROPE

Bearing Location is the Key to Long Service Life



JOY LIMBEROLLER® CONVEYOR IDLERS

Joy Limberoller Conveyor Idlers give many times the normal service life, because the two bearings rest in slots in the support brackets—well away from spillage. On underground conveyor lines, troughing is improved and belt life is increased because the Limberoller idler, mounted on wire rope stands, "gives" with the load. Limberollers have given many times the service life of steel idlers.

Limberoller Idlers consist of a neoprene coated wire rope to which are moulded neoprene discs. The ends of the rope turn in sealed bearings. This design not only eliminates clogging and freezing of the bearings, but also makes the idlers easy to service—they can be replaced while the belt is moving.

Limberollers are economical, not only because of long service life, but also because they can be spaced further apart than steel idlers. They are corrosion and flame resistant, self-cleaning, and eliminate the "bump" typical of steel idlers.

For complete details, write for Bulletin 352-3.

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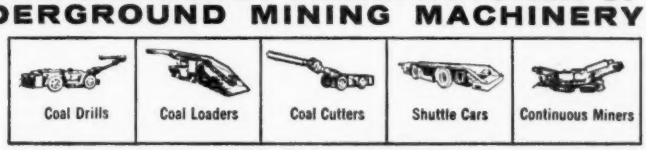

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BEFORE You Buy a THICKENER... BE SURE!

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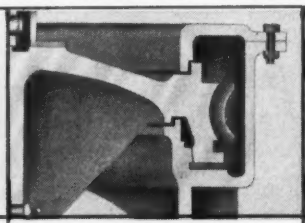
Let DENVER's 30 years of laboratory and world-wide field experience help you to eliminate risk—determine the right thickener for your needs—verify your own tests or recommendations of others. DENVER's experience covers a wide variety of materials plus the opportunity to relate test results to actual field operations. Laboratory tests, conducted at no cost to you, supply reliable data on

(A) Settling Rates **(D) Thickener Unit Area**
(B) Final Density **(E) Overflow Clarity**
(C) Effect of Flocculating Agents

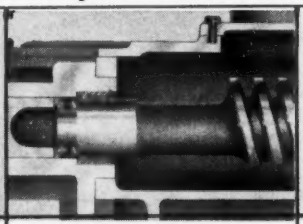
TESTS AT NO CHARGE—*These tests can assist you by eliminating risk of specifying a thickener that's too small to do the job or too large and costly for your needs.* Ship 5 gallon slurry sample prepaid to Denver Testing Division, 1755 Blake St., Denver, Colo.

Compare these distinctive features of DENVER Spiral Rake Thickeners:

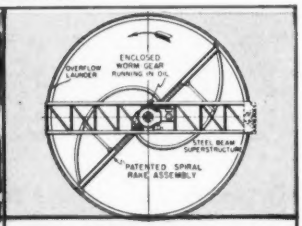
NEW ENCLOSED HOUSING protecting gear and drive mechanism is simple and rugged—available in sizes through 72" for light, medium, heavy and extra heavy duty. Tanks, steel or wood, in sizes to 150'. Write for Bulletin T5-B6.



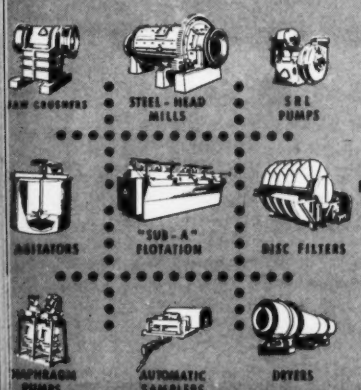
HIGH STRENGTH GEAR rides on replaceable no friction—no wear formica pads placed at periphery of the gear. Maximum stability, low bearing pressure and oil bath assure long life.



WORM AND WORM SHAFT are made from alloy steel, machined, case-hardened and ground. Shafts are proportioned to minimize deflection and retain full face gear-worm meshing.



SPIRAL RAKES move settled solids to center discharge port in only one revolution. Minimizes chance of choke-up, assures continuous operation. Why take 8 or 10 revolutions to bring pulp to the discharge cone when one revolution by the spiral rakes will do?



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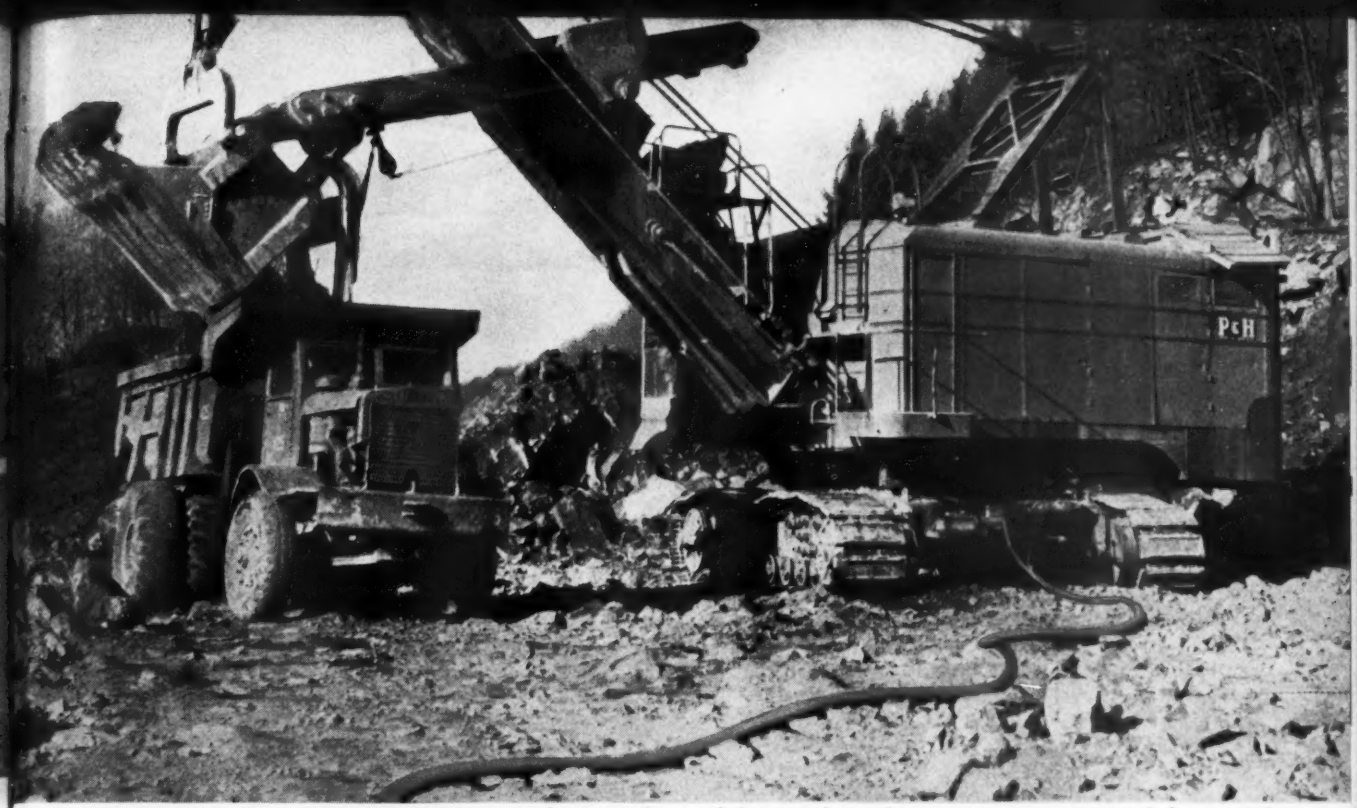
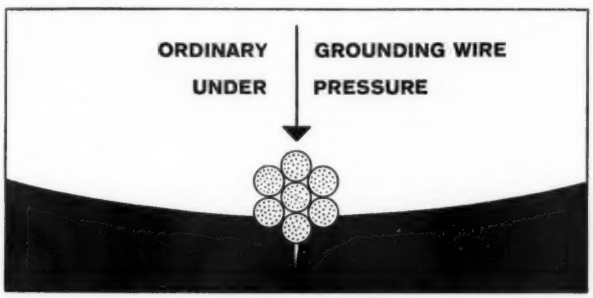
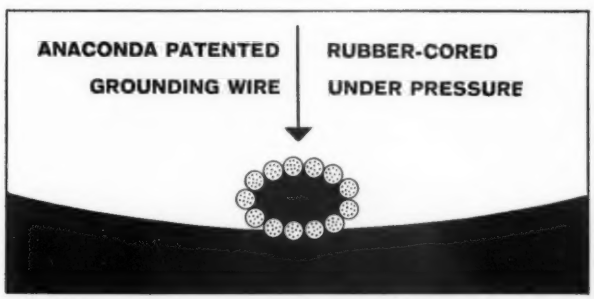


IN-USE SITUATIONS LIKE THE ONE SHOWN HERE prove why Anaconda Shovel Cable with its patented rubber-cored grounding wire outlasts ordinary cable. Under pressure, Anaconda's exclusive rubber core helps spread out the pressure—prevents internal damage. When ordinary grounding wires are subjected to the same pressure, the solid cores often cut the insulation.





Here's why Rubber-Cored Grounding Wires help Anaconda Shovel Cable last longer!

Abuse in service can seriously shorten the life of shovel cable—unless it has built-in protection, such as you find in Anaconda Shovel Cable. For grounding wire failures are one of the most common troubles. See how Anaconda engineers have solved it:

In the diagrams above you see, at left, ordinary grounding wire: a hard, compact group of stranded ropes. And at right, Anaconda patented rubber-cored grounding wire; flexible groups of stranded ropes around a soft *rubber core.*

When great pressure is applied to ordinary grounding wires, the small, hard grouping of wires bites into the insulation. Result: cut and damaged insulation. *But* with Anaconda grounding wires:

- Anaconda's rubber core acts as a cushion and helps spread out the pressure—resisting damage to the insulation.
- Individual conductor strands are protected, too, to resist the kinks that so often are the cause of fatigue failure.
- Anaconda's grounding wires provide broader contact with the shielding making a more positive ground.

For longer lasting shovel cable, see your Anaconda distributor or the Man from Anaconda. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 58319

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ASK YOUR **ANACONDA®** DISTRIBUTOR
ABOUT **SHOVEL CABLE**

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Export Distributor: Bethlehem Steel Export Corporation

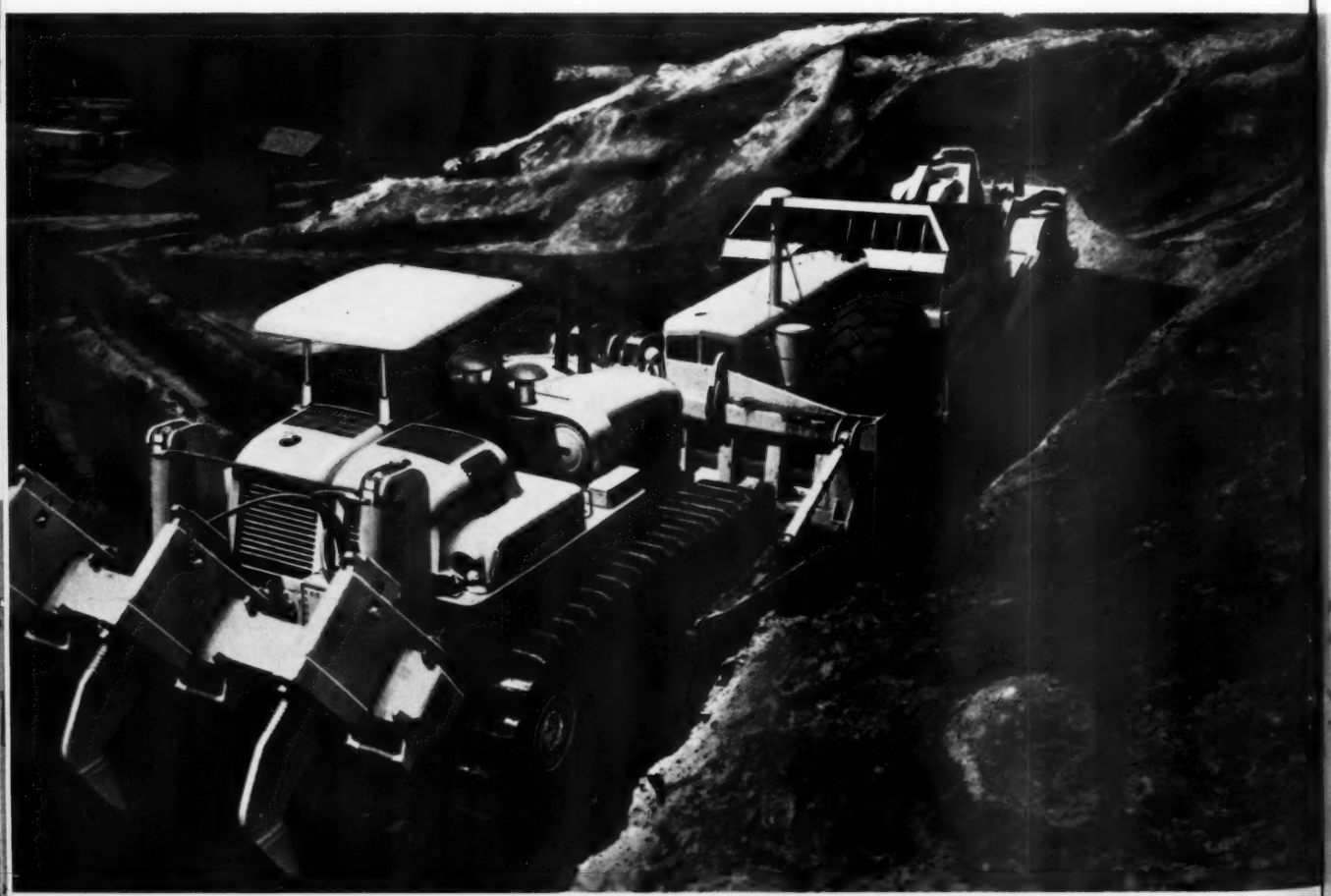
BETHLEHEM STEEL

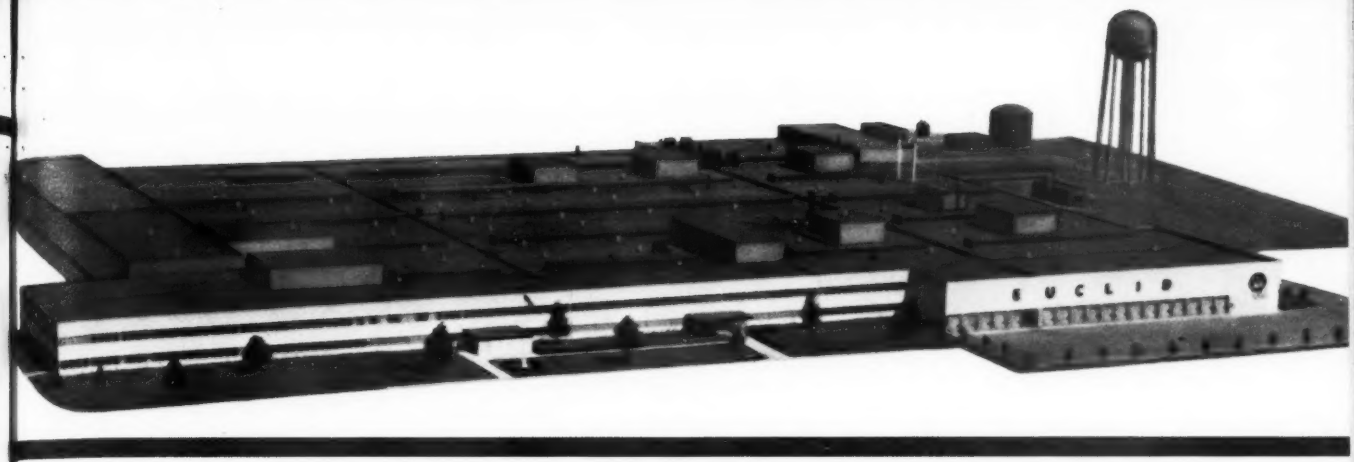
BIG CRAWLER TRACTOR NEWS FROM EUCLID!

C-6 Crawler now in production at Euclid's new tractor plant

A new concept in crawler tractor design, the Model C-6 is the most recent addition to the modern line of Euclid equipment developed and job proved during the past 5 years. Like the big twin-power TC-12 tractor, as well as 5 new scraper models and 4 new rear-dump haulers, the C-6 has the power, speed and versatility to get more work done faster and at lowest cost. All of these new "Eucs" incorporate years ahead engineering that has been a major factor in maintaining Euclid's leading position in the construction equipment industry for many years.

Now a big modern plant at Hudson, Ohio, designed exclusively for the manufacture of Euclid crawlers, is in production on Model C-6 and TC-12 tractors. Here every facility is provided to assure a uniform high standard of product quality that pays off in dependable long life performance of Euclids on every job.





C-6 sets a new standard in 200 h.p. tractor class

Brand new in every way . . . in functional design, ease of operation, service accessibility and productive capacity . . . but a "veteran" of many thousands of operating hours on a wide range of actual jobs and thorough testing at the proving grounds. No other machine in Euclid's history has ever been so completely proved for productive capacity and long service life before the start of volume production.

With 211 net h.p. and job proved Torqmatic Drive, there's a smooth, steady flow of power to match the work load. Changes from any speed range to another and from forward to reverse and back again, are made under full power . . . there are 3 speed ranges in forward and reverse, with a top speed of 7.9 mph.

Dry type air cleaner, full hydraulic track tensioning, independently suspended track frames and final drives, rear mounted cooling system, fewer lube points, and "package" assembly of major components are some of the other C-6 features that make this "Euc" outstanding for easy servicing and maintenance.

Compare and prove for yourself...

THE "EUC" C-6 IS THE LONG-NEEDED "STEP AHEAD" IN CRAWLER DESIGN

When you check all the things that really count in crawler performance . . . easy operation, maneuverability, power and traction for tough work, and minimum downtime . . . you'll see why the new C-6 is your best investment in the 200 h.p. class. No matter what the job is . . . heavy dozing and ripping, push-loading big scrapers, pulling heavy loads, stripping, land clearing, or handling stockpile assignments . . . the versatile C-6 cuts costs and gets more work done faster.

The Euclid dealer in your area will be glad to show you why the C-6 is your best bet for increased production at lowest overall cost.

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EUCLID DIVISION OF GENERAL MOTORS
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EUCLID (GREAT BRITAIN) LTD.
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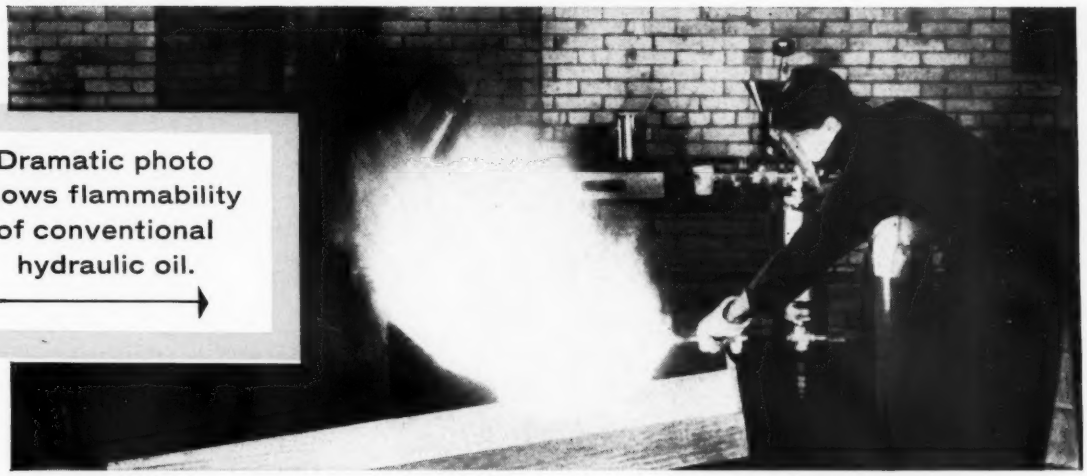
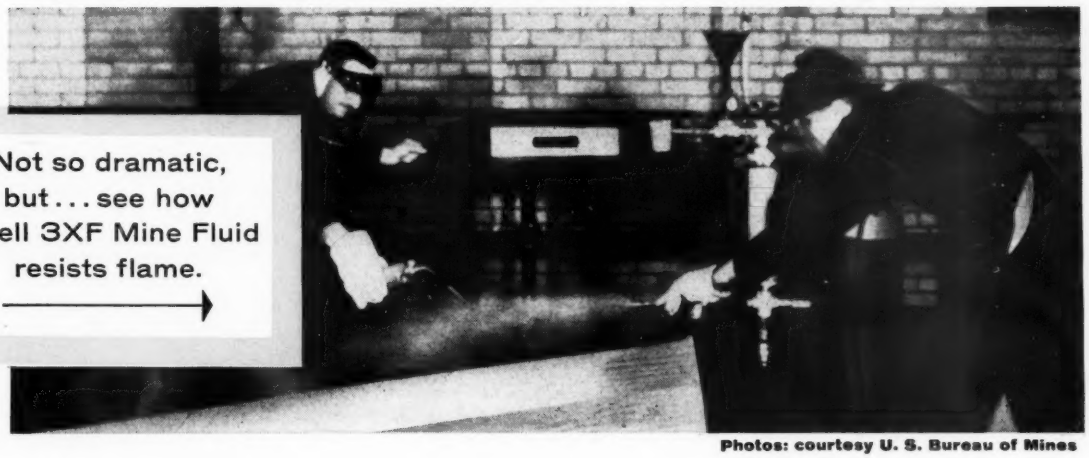


Dramatic photo shows flammability of conventional hydraulic oil.

Flame tests prove fire-resistant properties of this hydraulic fluid



Not so dramatic, but... see how Shell 3XF Mine Fluid resists flame.

Photos: courtesy U. S. Bureau of Mines

First low-cost fire-resistant mine fluid!

SHELL 3XF MINE FLUID HAS BEEN TESTED BY U.S. BUREAU OF MINES AND IS NOW IN USE

Now—for the first time in mining history—an inexpensive, fire-resistant emulsion-type hydraulic fluid is available for mine equipment use—3XF* Mine Fluid.

No major modification of equipment is necessary—Shell 3XF is a direct replacement for ordinary hydraulic oils now in service.

Convenient to use—Shell 3XF Mine Fluid, furnished as a concentrate, is mixed with water to prepare the emulsion *at the mine location.*

Proof of its fire-resistant qualities—In addition to recommending the use of fire-resistant hydraulic fluids in mining machinery, the Bureau of Mines has evaluated 3XF Mine Fluid using test methods that determine fire-resistant properties, and accepted it for mine evaluation, pending the establishment of a Bureau approval schedule.

For complete information on 3XF Mine Fluid, write or call Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

*Trademark

SHELL 3XF MINE FLUID

SHELL

Equipped with free-cutting Kennametal* U7J and J2 style bits, this Jeffrey Colmol loads a 2½-ton shuttle car in 30 to 40 seconds.

"Sure, bit costs are important . . . but it's tonnage that pays the bills"

Bit-cost-per-ton is at a new low but this company† buys Kennametal Bits primarily because of the way they cut coal

In Indiana County, Pennsylvania, the Miller "B" Seam averages 42 inches, and is characterized by a sulfur streak in the middle. This streak varies anywhere from a feather to about two inches thick. While the roof is fairly good, frequent bottom rolls of hard fire clay extend from 4 to 22 inches up into the bed. Under these conditions, the company had difficulty finding a long-lasting bit that would satisfactorily cut this seam. Not only did the machine have a slow rate of advance, but the heavy strain on the cutter heads resulted in an excessive power load. Then the company tried Kennametal Bits and not only obtained good production but relieved the excessive strain on the machine.

Ask your Kennametal Representative how Kennametal cutter bits and drill bits can improve *your* production. Let him help you select and actually test in your mine the Kennametal Bit designed to match your operating conditions. Call your Kennametal Representative or write KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania. B783

*Trademark †Clymer No. 2 Mine, Morrisdale Mining Company

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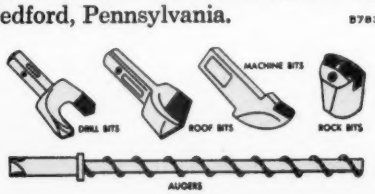


EDITORIAL

ROBERT W. VAN EVERA, Editor

NOVEMBER 1959

Signs of Progress

Another American Mining Congress Metal Mining—Industrial Minerals Convention is now history. In retrospect it is interesting to consider the significant attitudes reflected by the speakers and the audiences at this major convention.

From the industry policy viewpoint, several significant factors stand out. With major strikes in progress—in iron ore, copper and other branches of industry—interest in the Labor Session was extremely high. Senator McClellan should be commended for his straight-from-the-shoulder address which is published in full on pages 55 to 58 of this issue.

The need for a National Minerals Policy was again discussed, with congressional leaders and administration officials giving their views on the subject. Although no spectacular progress was apparent, there were indications that a sound basis now exists—through cooperation of industry, Congress and the Administration—whereby the problems of formulating wise national policies can be attacked and eventually resolved.

Industry leaders this year were more attentive to matters concerning taxation, the economic status of the industry, public lands, and national monetary policies, as demonstrated by increased attendance at the sessions devoted to these subjects.

Operating personnel attending the sessions seemed to be listening more intently—searching harder perhaps—for the information that might help them solve their own problems back on the job. The technical sessions were regularly and consistently filled with mining men who were on hand when a session began and stayed until the end.

This sort of attendance, of course, speaks well for the work of E. I. Renouard's Program Committee—which conceived the overall program and selected subjects and speakers. But in addition to this, it was apparent that most of the miners were trying—and trying hard—to get the maximum from every word spoken.

Just what the causes for this new attitude are we can't be sure—perhaps its a result of a certain amount of belt tightening due to prevailing strikes, or the impact of foreign competition moving boldly into America's home markets. At any rate, the keen interest shown in R. B. Jordan's talk covering a new installation of a folded belt conveyor of West German manufacture, in R. E. Kendall's account of the German bucket-wheel excavator and conveying practices, and in E. P. Leach's description of mining practices in various foreign countries—to mention only a few—indicates that American mine operators are going all out to find ways of offsetting rising costs and meeting competition from countries where wage scales are low.

In addition to the quest for new operating "twists" just noted, there was also much evidence that management men, or future managers, are growing increasingly attentive to the modern techniques of management and organization. The symposium on economic evaluation of proposed mining ventures, to which a full session was devoted on Tuesday morning, was proclaimed by many to be one of the finest sessions ever sponsored by the Mining Congress. It covered not only the subject of exploration and geology but showed how a whole series of special skills are necessary to a thorough evaluation in the modern sense. Although each specialist dealt with his own subject in detail, the inter-relationships among such matters as exploration policy and the costs of developing and operating a mine or processing plant came to light in significant fashion to give the broad picture of the organizational aspects of mineral evaluation.

Other examples of the more serious attention being given to management policies and techniques were the increased interest shown at the "Viewpoints on Safety" and "Management Problems" sessions on the last day of the convention. The latter, particularly, evoked healthy exchanges of floor discussion, and held the interest of the audience with such subjects as applications of industrial engineering, cost accounting practices, economics of equipment replacement, supervisory training, and engineering education for the mineral industries.

These new interests and attitudes in mine operating personnel bode well, we believe, for the future of the industry. And the sincere efforts now being put forth by mining executives, government leaders and staff specialists make it abundantly clear that the mining industry is going through a period of progress unsurpassed by any other period in the history of mining.

Underground Augering Under

By W. F. HAYDON
Vice President, and
TOM M. SHATTUCK
Mine Superintendent
Wind Rock Coal & Coke Co.

Faced with the fact that it could no longer mine coal economically enough to compete with other suppliers to TVA, Wind Rock Coal & Coke Co. turned to the coal auger as a possible solution

UNDEVELOPED coal seams in America with ideal mining conditions are becoming a thing of the past. This is becoming true at Wind Rock Coal & Coke Co., a division of Bessemer, Coal, Iron & Land Co. Wind Rock is located in the Cumberland Mountains, five miles north of Oak Ridge, Tenn.

Rock Partings Pose Problem

Production at present is from the Dean seam. It is 5½ ft thick and the ash and sulphur are inherently high. Washing the coal does not benefit the quality sufficiently to offset the tonnage loss. The total production is sold to the Tennessee Valley Authority on a delivered heat basis. Certain areas of the Dean seam have one or more rock partings varying in thickness and hardness. When this parting is reasonably soft and thin, a universal cutter is used to cut out the parting. Where the rock parting is thick and hard, this plan is not feasible.

Two additional seams are available in the present mineral rights of Wind Rock Coal & Coke. The Pee Wee seam averages three ft in thickness and has from 24 to 36 in. of draw slate which cannot be held during conventional mining. It is an excellent domestic coal, being low in ash and sulphur and high in heat value. The Wind Rock seam averages four ft in thickness and is also a good quality coal. It has been difficult to mine in the past because of the tendency of the bottom to heave.

Due to parting in the Dean seam, the draw slate in the Pee Wee seam, and the bottom in the Wind Rock seam, the company was faced with the fact that it could no longer mine coal economically enough to compete with the other suppliers to TVA. It was thought a coal auger might be the solution and several manufacturers were contacted.

Auger Made in Two Parts to Minimize Its Size

Salem Tool Co. was actively engaged in designing an underground auger machine. Two machines had already been fabricated and proven successful in the anthracite field. However, these machines were designed for drilling bore holes in preparation for shooting or holes for ventilation. The auger head was only 24 in. in diam, and actual coal production from the auger was not considered the primary objective. Wind Rock needed a machine that was easily maneuverable, compact and capable of producing coal economically.

The auger designed for Wind Rock was made in two parts—a power unit and an auger unit. This was done to keep the size of the machine at a minimum, allowing maximum maneuverability within the mine.

Power unit is 7 ft wide, 4 ft high, 9 ft long, and weighs 8½ tons. It carries two 50-hp, d-c permissible motors, and a 250-gal hydraulic storage tank, from which all movements of both units secure their power. The hydraulic oil is transmitted from the power unit by 50-ft long hose connections. It is maneuvered by two skids in combination with four jacks in the same fashion as the conventional outside hydraulic coal augers. Each skid

Difficult Seam Conditions

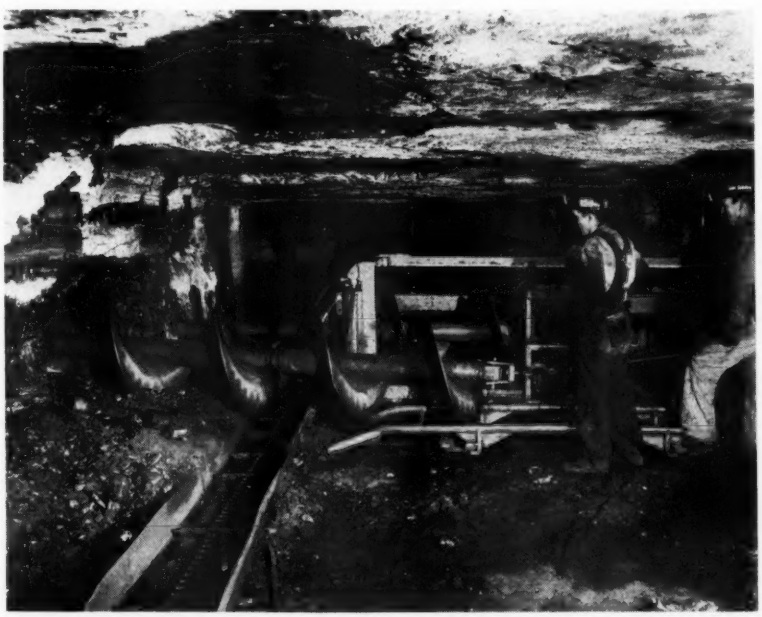
and jack is operated independently.

Auger unit is the production part of the underground auger machine. It is 7 ft wide, 4 ft high, 11 ft long, and weighs 9½ tons. The unit is maneuvered by four jacks and two skids in the same manner as the power unit. The bottom jacks will raise the auger unit 36 in., thus making it possible to position the machine at any height or inclination. Two roof jacks are provided at the rear of the machine to anchor the unit. These jacks extend a maximum distance of 36 in.

The auger head barrel is non-rotating and is 34 in. in diam. It has a pilot head holding seven carbide finger bits and three equally spaced arms holding three machine bits each. The head rotates at speeds from 0 to 35 rpm. To control direction of the head, once it is positioned in the coal, two runners made of angle iron are mounted on the barrel of the head. When there is difficulty of the auger head "wandering" while drilling a hole, the runners are positioned differently to offset the deflection. The carriage speed is from 0 to 12 fpm.

Augers Stored in Last Completed Auger Hole

For the storage of augers underground, where storage space is limited, it was decided to use one of the methods practiced in outside augering; that is, storing augers in the hole just completed. This method employs the use of two cutting heads and one string of augers, which in Wind Rock's case is 19 five-ft sections. Retrieving the augers from a completed hole is accomplished with a cable on the side of the machine independently operated by a hydraulic jack. When a hole is finished, the machine is positioned for the next adjoining hole. As augers are needed for advancing the new hole, they are retrieved from the completed hole. These scrolls are pulled into a portable cradle located on the machine skids. From this position the scroll is disconnected from the auger string by pulling out the conventional clip which connects them and is then ready to be rolled into position when needed for the advancing hole. This is carried on while the auger is drilling, which minimizes the time for auger changes.



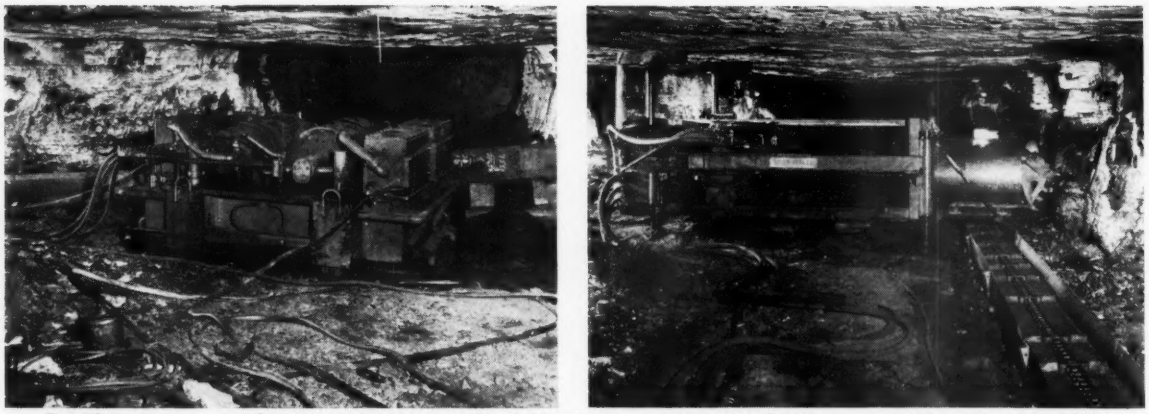
Because storage space underground is limited, augers are stored in the hole just completed. As augers are needed for advancing the new hole, they are retrieved from the completed hole by means of a cable on the side of the machine. Scrolls are pulled onto a portable cradle located on the machine skids, disconnected from the auger string and, when needed, rolled into position for the advancing hole

Controls for the auger unit are located at the left rear of the machine. The thrust and rotating controls are located on the drive unit and can be operated from either side of the machine.

Both the auger and power units have been designed to be transported on rail. Two trucks of 42-in. gage are placed under the units to allow moving them through the mine.

100-Ft Holes Drilled

The mining system presently used requires a conventional mining unit to drive three 400-ft entries off the main entries. These entries are driven 14 ft wide on 45-ft centers. Each set of entries is 200 ft apart. One hundred ft in from the main entry, the first auger hole is drilled 100 ft deep at right angles to the auger entry. The auger is then moved in to allow six in. between holes. When the machine has advanced to the face of the



The 18-ton auger was made in two parts—a power unit (left) and an auger unit (right). Each is maneuvered by means of two skids in combination with four jacks in the same fashion as the conventional outside hydraulic coal augers. Under average conditions the auger will drill 100 ft in one hour

400-ft entry, it is moved to the right-hand entry. Augering then starts at the face of the entry and retreats to a point opposite the original starting point, which is 100 ft from the main entry. The auger is then moved to a similar set of entries and the procedure repeated. Each set of entries, located 200 ft apart on the main entry, are augered. When the section is completed, the 100-ft wide barrier pillars left to support the main entry are augered. When roof conditions allow, a skeleton crew consisting of one loader and shuttle car, follow behind the auger and recover the coal left between the holes and the chain pillars. A crew of four men have loaded as high as 180 tons by this method.

Cross-Conveyor Designed to Transport Coal

At first, coal was transported from the auger to mine cars on a 12-in. chain conveyor, 500 ft long. It was installed in order to keep the initial cost to a minimum until the efficiency of the auger was proven. The conveyor was laid up the entry close to the solid rib and the auger was extended over it. Coal from the auger spilled into the chain conveyor and was carried to mine cars at the main entry.

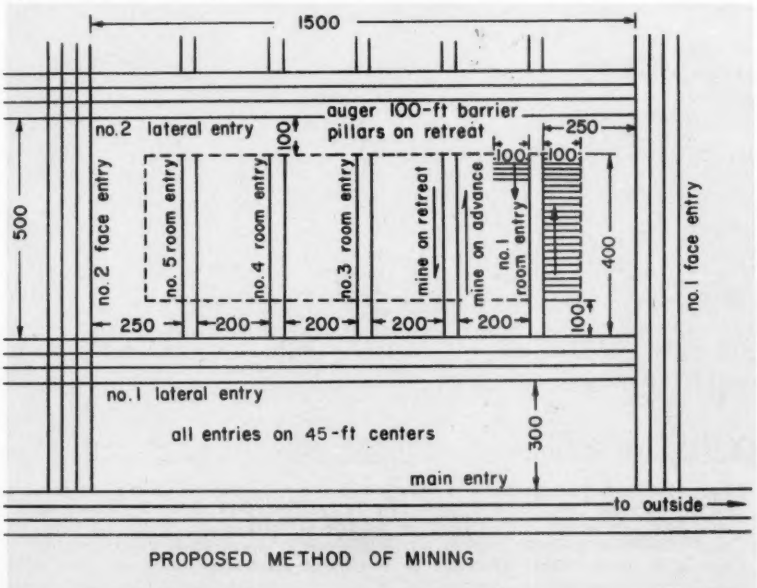
The chain conveyor used to convey the coal was not satisfactory. Too much time was required for conveyor set-ups. Salem Tool designed a cross-conveyor mounted immediately in front of the auger unit. This carries coal to a modified Piggyback conveyor, which elevates it into a shuttle car. Two shuttle cars are used; one to act as a surge car and the other to haul coal to the mine cars. The cross-conveyor and Piggyback are operated from the same push-button switch, located on the operators side of the auger. The conveyor chain on the surge car is operated remotely by push button from the operator's side. This method has proven much more flexible than the chain conveyor.

Production Goal Is Five to Six Holes Per Shift

Under average conditions the auger will drill 100 ft in one hour. Moving the auger from one hole to the next and resetting takes approximately 20 minutes. When an auger section is added it takes an average time of 20 seconds to pull back the carriage and 15 seconds to add the new section. Penetration of a 5-ft auger section requires two to four minutes depending on hardness of the coal and length of auger strings. Production from each 100-ft hole is about 23 tons. The production goal is five or six holes per shift. Theoretical recovery from this size auger is about 50 percent, allowing six in. between holes.

As can be expected in all new prototype equipment certain bugs were present, however, they were not of a major nature. Some changes were necessary to strengthen the equipment, some were made to speed up certain operating functions, some were made for aiding the operators, and some were made due to changing conditions in the mine proper.

The other benefits of an underground auger are plainly evident. Danger of roof falls at the face are minimized. The ability of the auger to allow selective mining will enable many companies to mine seams which otherwise, due to roof or seam conditions, could not be operated economically. The short experience at Wind Rock indicates this type of mining will enable the profitable recovery of coal from areas which had been uneconomical to mine by other methods.



PROPOSED METHOD OF MINING

Economic Evaluation of Proposed Mining Ventures

—a series of six articles covering the subject from initial exploration work through financing the enterprise. Parts I and II are presented in this issue to be followed in forthcoming issues by Parts III through VI

Part I — EXPLORATION, GEOLOGY AND ORE RESERVES

By EVAN JUST
Executive Head
Department of Mineral Engineering
Stanford University

NO mineral deposit is brought into production without exploration costs, acquistion costs, investments in development and plant, operating costs and the costs of getting the products to market. It follows that no deposit has worth except in terms of producing income in excess of these costs. Thus, the exploration executive or consultant who fails to establish the proper perspective does not serve his company or client well.

Most Ore Bodies Predictable

In early-stage ventures, particularly in remote places, it is usually not possible to go into all the detailed calculations with great accuracy. For example one cannot do more than guess at transportation costs where no facilities exist, compute investments without knowing the size or nature of the plant involved, or estimate smelter returns if the character of the ore is unknown. Nevertheless, some kind of an educated guess should be made. Otherwise, exploration funds might be committed where no reasonable chance of attractive profit exists.

It might be objected that income and amortization calculations cannot be made in the absence of a known grade and tonnage. This is true to the extent that one cannot allow for the very unusual prize, but most areas are likely to have types of ore bodies that are somewhat predictable.

Proposed mining ventures in the pre-development stage are based on a wide range of possibilities, including the following:

(1) Favorable geologic setting
(2) Large area, likely to be mineralized
(3) Technical concept, such as a geochemical stream survey or geophysical reconnaissance
(4) Geophysical or geochemical anomaly
(5) "Showing" of mineralization
(6) Mineralization exposed by trenches, test pits or shallow drilling
(7) Mineralization blocked out to the practicable limit of drilling or underground work
(8) Producing, shut down or abandoned property, considered to warrant fresh exploration

According to the state of knowledge which exists, one can begin at the appropriate step in the following typical procedure:

(1) Prospecting for showings, detailed study of geology, aerial photography, geophysical or geochemical reconnaissance, or any combination thereof
(2) Detailed geophysical or geochemical survey
(3) Trenching, test pitting or shallow drilling
(4) Deep drilling or underground prospect working

Limit Safety Factors in Computations

To size up a venture in any stage requires judgment based on both technical knowledge and experience. Early-stage work, unless conducted on a grand scale, is usually less expensive, thus prospecting detailed geologic studies, trenching, etc., are frequently recommended in the belief

Sound evaluation of a prospective mine requires judgment—based on both technical knowledge and experience

that a situation is in general favorable. However, as exploration becomes more expensive calculations to justify further work should be made with a degree of accuracy consonant with existing circumstances. In this connection, it should be pointed out that the computations should represent the best opinions of the estimators, without important safety margins. If all factors of an estimate are separately hedged in with safety margins, condemnation of valuable properties is likely to be the result.

Questions that higher management or clients want answered are likely to be along such lines as:

(1) Does the grade, with due regard to location and estimated operating costs, seem commercial, or does it have a reasonable chance to be proven commercial?

(2) Is the tonnage adequate to produce a profit above the income necessary to amortize the expectable investment, or is there a good chance to prove this?

(3) Is the market encouraging for the proposed product?

(4) Can an attractive profit be realized? Many answers are possible here. Some integrated companies are willing to proceed simply to be assured of a hedge against high raw-material costs. Most of them will want the proposed mining venture to make some profit of its own, or assurance that their over-all operations will be competitive. Other venturers are willing to break even for the present if the not-too-distant future seems promising. Some want a payout over a number of years and some in as few as five, or even three.

(5) Is the property an attractive "hold" for future development?

Commitment of funds to proposed ventures may have other complications. The corporate exploration executive will usually be required to operate on a given budget and has to spread his commitments accordingly. Also, company or otherwise, it is prudent to determine if the proposed program will condemn the property or yield sufficiently encouraging results to make further financing feasible. An exploration man can find his position both awkward and distressing if results are simply inconclusive, or if he gets into a situation where his sponsors cannot afford to proceed or cannot obtain outside money on reasonable terms. He is also vulnerable if he makes a practice of taking twenty to one shots for three to one rewards.

Other considerations which may not seem economic at the outset can subsequently become decidedly economic and embarrassing, such as:

(1) Are title problems likely to arise?
(2) Are the proposed partners desirable?
(3) Is the political climate favorable?
(4) If the proposed venture is in a foreign country and the local associates are political "ins," are they likely to be "outs" before long?

Intervals at which samples are taken should allow for separating tonnages at various grades, possible selective mining or positions of benches or stopes

Multiple Approach Desirable

An exploration man is in a fortunate postion if his sponsors are farsighted enough to be willing to pay for comprehensive knowledge about the commodities in which they are interested. This enables him to keep abreast of markets and competition, and to weigh the merits of various alternative opportunities. This multiple approach, although expensive, is likely to be most successful in the long run, particularly if the sponsor is in a position to weigh in costs of the final product on an integrated basis.

In many instances where the environment of deposition is known, expensive work can be minimized by confining activity to environments which appear to conform, such as areas of unusual deformation. Also, in some cases characteristic alteration phenomena are likely to be asso-

ciated with mineralization, and work can be limited to places where such alteration is recognizable. Such tools as geophysical or geochemical prospecting are commonly used to limit the objectives of more expensive work. However, in using these tools or in programming extensive geologic study, the exploration man should be sure that he cannot resolve his problem more economically by going directly to drilling or digging, which usually has to be done anyway.

Sampling Imperfect

Part of the exploration job is to compute reserves when they are established. There are numerous complications in such calculations. The intervals at which drill holes, test pits or other underground samplings should be made cannot be readily formulized. In areas of persistent sedimentary deposits, such as the Witwatersrand, coal or bedded salt deposits, very wide intervals can be used, and experienced people have committed tens of millions of dollars on as few as three or four drill holes. By contrast, some irregularly mineralized deposits may have to be sampled on fifty-foot coordinates. Experienced judgment usually enters here. However, as a rule of thumb, an interval can be considered adequate if computations using intervening check intersections do not alter the conclusions.

The intervals at which samples are taken in individual drill holes or workings are important. They should allow for separating tonnages at various grades, for possible separation of ore from waste in selective mining, or the positions of benches or stopes. In case of doubt it is always wise to select a short interval rather than a large one.

No sampling method is perfect, and allowances must be made for inaccuracies. This is usually done through some form of comparative testing, such as checking drill holes with test pits. Where possible, bulk sampling is desirable.

Before development is undertaken, ore reserves are usually measured. This is done by computing a given tonnage and grade or various possible tonnages and grades for each intersection. In a typical drilled area, for example, the triangles, quadrilaterals or polygons, for which the drill holes are corners, are computed as having the weighted average thickness and grade of the bounding drill holes. Or polygons are established by boundaries half way between each pair of adjacent drill holes, and the grades and thicknesses for each polygon are considered to be those of the drill hole at the center. Numerous variations of these methods exist. Also, in order to convert volume to tonnage, the density of the rock must be established, and allowances made for variations in rock character. Allowances should be made for dilution during extraction and, if feasible, for metallurgical losses.

Risk in Any Venture

In conclusion, the author wishes to sound a note of warning against being too exacting in judging new exploration ventures. Most of the mines which have been developed up to and including the present time were not found by teams with sophisticated business judgment, but by the lucky few who gambled against illogical odds. This kind of competition and that of integrated companies seeking reserve insurance still sets the pace in exploration for mines. In short, if business groups wish to find mineable deposits, they should be prepared to gamble beyond the point suggested by their own traditions, and to expect many disappointments before a real prize is brought home.

Part II—MINE DEVELOPMENT AND MINE OPERATING COSTS

By JOHN W. CHANDLER
Mining Engineer
American Metal Climax, Inc.

THE evaluation of any proposed mining venture involves a series of technical and economic studies based on educated estimates and judgment factors. Mines have a limited life and the evaluation must take into account the recovery of invested capital during the life of the property. Any study of operating costs should, therefore, be accompanied by an estimate of the capital requirements for the operation.

Factors Required for Evaluation

In developing the full economic picture for any mining program, it will be necessary to have the following information:

(1) Estimated Ore Reserves
  (a) Ore reserves and indicated grade
  (b) Amount of mineable reserves based on mining method to be used
(2) Estimated Production
  (a) Rate of production—tons milled
  (b) Net sales value of product f.o.b., mine (after royalties)
(3) Estimated Life of Mine
(4) Estimated Operating Costs
  (a) Mine
  (b) Mill
  (c) Overhead
  (d) Other
(5) Estimated Capital Requirements
  (a) Land acquisition and exploration
  (b) Mine plant and equipment required to bring property into production
  (c) Mill and related facilities
  (d) General surface plant and other facilities
  (e) Pre-production development cost
  (f) Capital additions to plant and equipment during the first few years of operation
  (g) Working capital

These are the basic figures which are required to develop the financial analysis. For the purpose of this article, however, only the factors directly related to the mine will be covered.

Ore Reserve—It is assumed that exploration work has indicated an ore deposit of a given tonnage and grade, and that all factual data collected in the course of drilling and other work are available for study. A complete review of all drill logs, cores and other data should now be made from the standpoint of mining.

Mine Development—No two orebodies are identical. They differ in size, shape, position, depth from surface, grade, distribution of values,

structure and surrounding rocks. In order to lay out an intellgent program of development for the extraction of an ore deposit, as much as possible should be known about its physical characteristics and mode of occurrence.

Exploration drilling generally gives good results in delimiting evenly mineralized flat-bedded deposits and large ore lenses or masses, and has been particularly successful in the development of the prophyry copper deposits. On the other hand, vein-type and many replacement type deposits with small steeply dipping ore lenses cannot, as a rule, be adequately explored by surface drilling, and underground development is necessary to supplement surface exploration. It may be necessary to sink a shaft and do considerable development work before locating the main extraction openings. Insofar as possible the development work, which actually is another step in the exploration program, should be laid out so that it will integrate with final development plans.

The fundamental purpose of development is to delimit the ore body and prepare it for extraction. From the development workings, the shape, position, approximate quantity, approximate average value and physical characteristics of the ore and enclosing wall rocks are determined. Exploration drilling may not supply enough of such information, and it is often necessary to do a considerable amount of development work in order to decide on the mining method or combinations of methods which should be used. Development work is costly and time consuming, and as much development as possible should be completed before the mine plant and equipment for working the property is decided upon. This is very often neglected in the rush to get into early production.

Some of the important points to be considered in planning mine development for economical operations are: (1) Size of the operation—tonnage rate and life expectancy of the mine, (2) location of main extraction, service and ventilation openings, (3) decison as to type of openings—shafts, adits or inclines, (4) time required to complete pre-production development work and control drainage, (5) level interval, (6) most efficient level layout for extracting the ore and for servicing and ventilating the mine under the selected mining method and (7) water conditions and pumping problems.

The main mine openings usually serve for the life of the mine; therefore, production and service openings should be centrally located with respect to the ore bodies, situated so that they will not be disturbed by ground movement caused by ore extraction, and with a view to low maintenance costs.

Level intervals for most underground mining methods vary from 100 ft to 150 ft. In block caving, the levels would be established at horizons which would afford the best arrangement for caving. The height of the blocks are limited by the shape and size of the ore body, but generally range from 125 to 300 ft. In some cases, as at San Manuel, blocks up to 600 ft high are being caved.

The size of development headings are governed by the services they perform. Provisions must be made for haulage of ore, servicing work at mining faces and for adequate ventilation.

Development work should be planned so that it will be well in advance of mining operations. In most mines it is advantageous to be able to produce from several levels simultaneously. This provides a large number of faces for production and generally supplies a uniform grade of ore for the mill.

In general, development and underground exploration should be pushed at an efficient pace considerably in excess of the demands of production during the early years of a mine's life. This affords time for the orderly preparation of new stoping areas. When the full potential ore reserve has been assessed and the optimum rate of output has been achieved, the rate of development work can be reduced to an amount which would balance extraction.

Although it is not possible to cover the subject of open pit development in this article, there are a few basic factors which should be noted.

Any development program for an open pit operation should involve long range planning. In order to do this it is necessary to have relatively complete information, as to the shape, attitude and grade of the ore body, which can usually be obtained from drilling.

Basic factors to be considered in pit planning are: (a) cut-off, (b) over-all stripping ratio, and (c) production rate. In making any long range plans, it is necessary to finalize pit design in order to plan properly for the type and location of the mine-haulage system, service facilities and for waste disposal. Haulage of ore and waste may be by rail, trucks, belt conveyors, skip installations, or any combination of these methods depending on physical conditions of the pit.

One of the major decisions which must be made is whether stripping should be done by the company or a contractor. Stripping represents a large capital investment in equipment which may not fit into the mining plans. A contractor would probably be chosen in the case of a deposit requiring a rapid stripping job. Also, if a smaller pit were to be developed or the company had little previous pit experience, it might be more economical to employ a contractor.

Table I. Direct Mine Operating Costs for Various Mining Methods, Period 1955-59

Mining Method	*Tons Mined Per Month*[1]	*Direct Mining Costs/Ton*[2] *High*	*Low*	*Average*[3]	*Labor-Percent Of Total Cost*[2]
Square Setting	439,330	$18.72	$6.22	$10.20	71.2%
Cut and Fill	585,300	14.73	3.07	6.69	56.7
Shrinkage	305,820	8.12	1.75	3.92	N.A.
Room and Pillar (Trackless Type)	733,220	2.41	1.16	2.05	43.7
Sub-Level Stoping	1,547,410	4.71	1.06	2.37	56.9
Sub-Level Caving	118,150	N.A.	N.A.	4.97	63.3
Block Caving	1,803,150	2.25	1.15	1.41[5]	54.2
Open Pit[4]	5,198,060	1.15	.21	.32	36.4

[1] Total aggregate tonnage of ore mined each month except for open pits (see footnote 4).
[2] Includes exploration and development, stoping, haulage, hoisting, pumping, and general underground and surface costs.
[3] Weighted average on the basis of tons produced from each mine.
[4] Cost is per ton of "material" and is based on total tons of ore and waste handled.
[5] This average may be on the high side due to lack of information covering a number of efficient operations.
N.A.—Not Available.

Selecting a Mining Method

The principle objective in mining any deposit is to produce each unit of metal at minimum cost with maximum safety. This entails an examination of the conditions prevailing in an ore body and its surroundings, for the purpose of selecting the best method or combination of methods for its removal. Some of the factors which must be considered in selecting a mining method are: (1) Distribution of values and probable waste dilution which may be expected, (2) number and type of ore

Table II. Explosive Consumption for Various Mining Methods

Mining Method	Ground Condition	Lbs. Explosives Per Ton Broken		
		Pillar Mining	Stoping	
			Range	Average
Square Setting	Weak	.20	.30–1.08	.5
Cut and Fill	Medium	.30	.50–1.23	.7
Sub-Level Stoping	Strong	.26	.33– .59	.4
Room and Pillar	Strong		.67–1.14	.8
Block Caving	Weak		.08– .19	.14
Block Caving	Medium-Strong		.23– .47	.35
Open Pit			.10– .53	.28

Table III. Timber Consumption for Various Mining Methods

Mining Method	Board Ft. Per Ton Mined	
	Range	Average
Square Setting	12.0–19.7	15.1
Mitchell Slice	7.5–10.5	9.3
Cut and Fill	.8– 7.0	4.5
Shrinkage	.4– 3.9	1.9
Open Stopes (small)	0– 1.7	.7
Sub-Level Stoping	1.0– 2.0	1.5
Block Caving	0– 2.0	1.2

bodies involved and their relative proximity to each other, (3) possible application of selective or non-selective methods of extraction, (4) structural features, such as faulting, which may have offset ore blocks, shear zones, joining or other rock defects, which might affect mining, (5) ability of the ore and surrounding rock masses to withstand the effects of stresses induced in them by mining, (6) time factor involved in maintaining extraction openings and (7) possible fire hazard in broken masses of pyritic ore.

The selection of a mining method is based primarily on economics and safety but, other things being equal, the method chosen should be as flexible as possible and designed to meet possible unforeseen conditions. When an inflexible method is confronted with conditions for which it was not designed, a major change of method is required usually at high cost. To be successful under modern competitive conditions, a system of mining must be worked out in detail with careful time scheduling for a balanced production. There are many mines where widely varying characteristics of the ore body require two or more mining methods for the most economic extraction of the ore.

Open pit mining usually has a cost advantage over underground methods and should always be considered first for any near surface deposit. Though there are conditions where open pit or underground methods may appear equally applicable to the same ore body, this is the exception rather than the rule and, after a preliminary survey, a competent engineer can usually tell which method would apply. Generally speaking, when the ratio of waste to ore in a low grade ore body exceeds 3:1, serious thought should be given to the possibility of mining by some low cost underground method. In cases where large lean or barren masses exist within an ore body and a selective system of mining is required, an underground mining method might have an economic advantage over an open pit. These decisions must be based on a comparison of costs, bearing in mind such items as the greater quantity of waste that must be charged to ore mining in an open pit, the greater tons per man shift output of a pit, the greater complexity of underground mining and many other economic factors. The stripping ratio is a basic factor for determining whether to employ open pit or underground methods, and for determining the economic limits of open pit mining.

Underground mining methods naturally fall into two classifications, (a) supported stopes, and (b) caved stopes. In general, block caving attains the lowest mining cost per ton followed in turn by trackless room and pillar and sub-level stoping. The higher cost methods generally involve support problems, and in this category cut and fill and square setting probably top the list; the cost of the other methods falling somewhere between.

Table IV. Drill Bits and Rods Average Cost per Foot of Hole for Various Drilling Rates

Type Drill—Bore & Rate of Penetration	Bit Size In Inches	Bit Life In Feet	Bit Cost (each) $	Cost Per Ft Hole $/Ft	Steel Size	Steel Life In Feet	Steel Cost $	Cost Per Ft Hole $/Ft
Jackleg 2⅝"								
Over 30"/min	1⅝	1500	12.85[1]	.009	⅞" × 4¼" sh	3000	17.00[2]	.009
20 to 30"/min	1⅝	700	12.85	.018	Alloy Steel	1500	9.00	.017
15 to 20"/min	1⅝	500	12.85	.026	8 ft section	800	26.00	.033
Drifters 3½"								
Over 30"/min	1⅝	1500	15.15[1]	.010	1¼" lug	3000	31.10[2]	.014
20 to 30"/min	1⅝	700	15.15	.022	carbon steel	1500	9.50	.027
15 to 20"/min	1⅝	500	15.15	.030	12 ft section	800	40.60	.051
Drifters L.H. 4"								
Over 30"/min	2	1500	18.05[1]	.012	1" hex. exten.	2000	17.50	.009
20 to 30"/min	2	700	18.05	.026	carburized steel	1500	17.50	.012
15 to 20"/min	2	500	18.05	.036	4 ft section	1000	17.50	.018
Crawl-IR 4½"								
Over 30"/min	3	3000	47.20[1]	.016	1¼" hex exten.	4500	45.00	.010
20 to 30"/min	3	1500	47.20	.031	carburized steel	2500	45.00	.018
15 to 20"/min	3	500	47.20	.094	10 ft section	1500	45.00	.030
Drillmaster (DHD) 3¼"[4]								
Over 30'/hour	6	10000	425.00[1]	.043	4" OD alloy	47000	470.00	.010[3]
20 to 30'/hour	6	2500	425.00	.170	steel tubing	47000	470.00	.010
15 to 20'/hour	6	500	425.00	.850		47000	470.00	.010

[1] Bit cost includes reconditioning cost on the following basis: grinding wheel cost $5.00 each—Labor at $2.00 per hour.

1⅜"	Bits—100 regrinds per wheel				
1⅝"	"	100	"	"	"
2"	"	50	"	"	"
3"	"	25	"	"	"
6"	"	3	"	"	"

[2] Reconditioning cost at $1.50 per thread or per shank for over-all of six reconditionings per rod.

[3] Low steel cost because down-the-hole drill transfers no energy through steel.

[4] "Down-the-hole" type drill.

A rough idea of the range of mining costs for various mining methods is given in table I. The comparison covers only a limited number of operations. There are undoubtedly many operations which fall outside of these ranges. At best these figures are only indicative of what is currently being done.

Application of Mining Methods

The use of a selective or non-selective method of mining is based primarily on the distribution of values and shape of the ore masses. In general, selective methods are preferable where high grade ore can be produced from a number of ore lenses, which may be irregular in shape. Non-selective methods, designed to achieve low mining costs are generally applied to large comparatively low grade deposits with a uniform distribution of values.

Choosing a low cost method of mining does not necessarily produce the lowest cost per unit of metal recovered. The non-selective nature of low cost methods may increase waste dilution to the point that the combined cost of mining and treating the mine output may be greater than the cost of mining and treating ore using a higher cost selective method. Low grade ores generally require mining on a large scale to obtain unit costs low enough to insure a satisfactory profit. On the other hand, if the ore is high grade, greater profit is generally realized through complete extraction of the ore using one of the higher cost selective methods of mining.

Optimum Size of Mine Plant

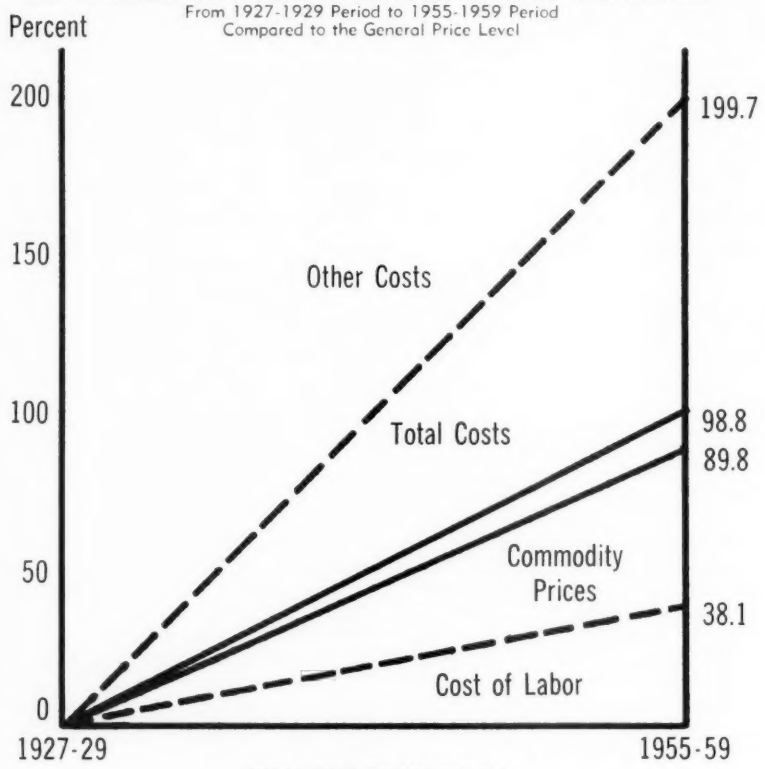
The optimum output rate for any mine is primarily based on the ability of the mine to produce ore. This is governed by the size of the ore deposit, the size of the mine plant and amount of equipment which is provided. Production is also limited by the rate at which development work can be done and, in the early stages of a mine's life, development is usually the bottleneck for production. In order to increase output, development work must be pushed ahead at a more rapid rate than that demanded by current extraction.

An increase in the rate of production results in lowering unit costs due to spreading fixed costs over a greater tonnage. The items making up fixed costs usually amount to from 10 to 20 percent of the total mining cost and, since they are more or less constant in terms of total dollars, have a decided influence on mining costs when the rate of output varies. Operating on a large scale also results in minor economies throughout the whole plant, not entirely included in the fixed costs. It is apparent, therefore, that the lowest operating cost will be attained by working the mine at the highest possible production rate. This is limited, however, to the ability of the mine to supply this tonnage of ore efficiently. One should keep in mind that it is better to plan on an output slightly below rather than above the capacity of the mine.

Any appreciable increase in output requires a larger mine plant and equipment which can be justified only by savings of "fixed charges." This requires time and the visible life of a property becomes important from the standpoint of paying off the investment. Hence, no increase in mine plant and equipment is warranted unless the cost can be returned within a reasonable length of time. The optimum rate of output, then, is an economic balance between investment and life of the property.

In general, a mine does not reach its full potential output during the first few years of its life. It is common practice to build a mine plant in units of mill capacity, providing space in the mill building for additional units which would be installed when the mine has attained the ability to supply the extra output. The writer knows of a number of instances where the mine plant has been designed and built for a capacity beyond the production limits of the mine. This is a serious mistake which defeats its own purpose. When production is demanded at a rate equal to, or in excess of the ability to develop ore for extraction, costs inevitably go up. In the struggle to maintain output, an excess amount of waste is generally taken which lowers the grade of ore and increases handling costs. In addition, the mine is forced into a costly "crash" program of development in its attempt to keep up with

FIG. 1. PERCENTAGE INCREASE IN COSTS OF ROOM AND PILLAR MINING
From 1927-1929 Period to 1955-1959 Period
Compared to the General Price Level

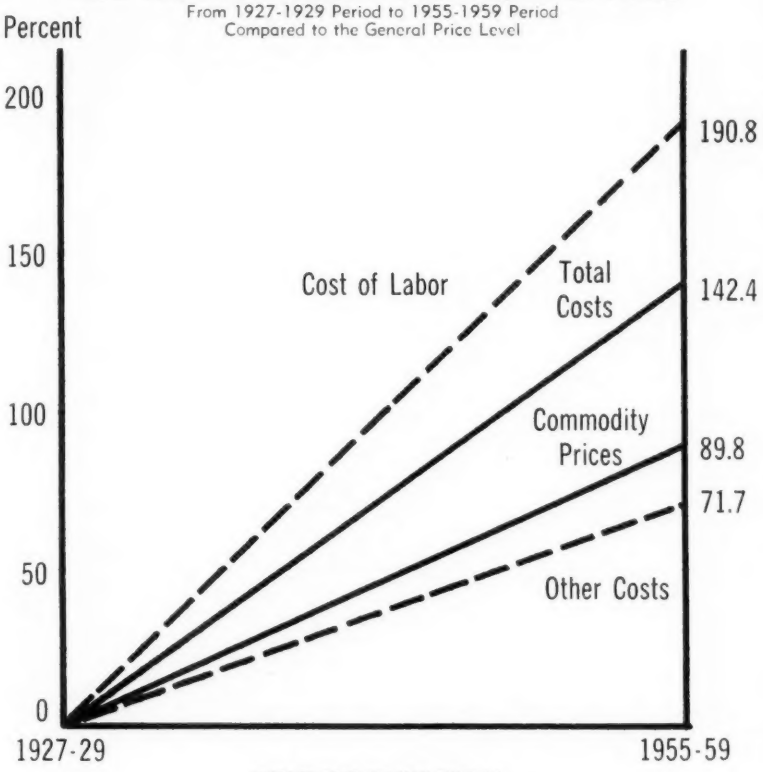


AVERAGE TONS PER MAN SHIFT 23.3

	1927-29[1]	1955-59[2]
Cost of Labor per Ton	$ 0.648 (63% of total)	$ 0.895 (44% of total)
Other Costs per Ton	0.381	1.142
Total Cost per Ton	1.029	2.046
Wholesale Price Index[3] (1947-1949=100)	66.4 (1928)	126.0 (1958)

1 Represents operations with an aggregate production of 228,330 tons per month.
2 Represents operations with an aggregate production of 733,220 tons per month.
3 U.S. Bureau of Labor Statistics Wholesale Price Index—All Commodities Other Than Farm and Food.

FIG. 2. PERCENTAGE INCREASE IN COSTS OF SQUARE SET MINING
From 1927-1929 Period to 1955-1959 Period
Compared to the General Price Level



AVERAGE TONS PER MAN SHIFT 3.9

	1927-29[1]	1955-59[2]
Cost of Labor per Ton	$ 2.496 (59% of total)	$ 7.258 (71% of total)
Other Costs per Ton	1.711	2.938
Total Cost per Ton	4.207	10.196
Wholesale Price Index[3] (1947-1949=100)	66.4 (1928)	126.0 (1958)

1 Represents operations with an aggregate production of 139,240 tons per month.
2 Represents operations with an aggregate production of 439,330 tons per month.
3 U.S. Bureau of Labor Statistics Wholesale Price Index—All Commodities Other Than Farm and Food.

extraction.

In the case of an operation involving a large ore deposit where tonnage and grade are pretty generally known, it is possible to calculate at once the size of plant which, by saving of "fixed costs" would be eventually the most economical. The volume of output becomes very important in low grade mines where, if the mine plant is too small, no profits at all could be earned; therefore, a sufficient production is absolutely imperative and a production rate is generally selected which would give the lowest cost commensurate with the investment over a reasonable life.

Operating Cost Estimates

No two mines are alike; therefore, costs which can be achieved in one mine cannot be compared directly with another operation. The operating costs of a producing mine similar to the proposed venture are useful as a guide and check in making cost estimates, particularly if the known costs are broken down into their basic elements, and these comparisons often serve to point out factors which may have been overlooked. There are no easy short cut methods whereby operating costs can be estimated with any degree of accuracy. Good reliable cost estimates require a painstaking study of all the basic factors which, in the aggregate, go to make up costs.

It must be assumed, at the outset, that the mine would be operated with a reasonable degree of efficiency. The selection of a competent well qualified management and supervisory team is imperative for good performance. It is always an advantage to have the prospective management team take part in making cost estimates, for in the last analysis, this group must be willing to agree to the figures if they are expected to live up to the forecasts.

It takes time to bring a mine into production and the economics must, of necessity, be based on results over a number of years. In making a cost study for a new deposit, one is forced to make a number of assumptions, any of which may later be proved wrong; hence, an engineer should be cautious and conservative in his judgment.

At this point in the study, the mining method or combination of methods, and a probable production rate will have been selected. In order to arrive at the optimum production rate, the economics of operating at several rates of output bracketing the probable production rate should be studied.

The various mining programs should be laid out in detail on an annual basis over a number of years. This long range planning involves drawing up a series of plans and sections of the ore bodies and working out the details as to how the mine will be opened up for extraction. A selection must be made of the most economical means of access to the deposit, whether by shafts, inclines or adits, and the extraction, service and ventilation openings must be located. Following this, the development and stoping programs would be laid out and a complete time schedule would be drawn up to integrate all phases of the operation. As there are several tonnage rates to be considered, and a possibility that alternate mining methods might be used, each should be set up as a separate study so that the economics of an operation under each plan can be compared. In effect, this amounts to mining out the indicated ore body on paper, and an attempt is made to visualize and overcome all of the problems which may be encountered in an actual operation under the various assumed conditions.

Operating Cost Major Item

The next step would be that of making an estimate of the operating cost for each of the plans. Operating costs derive from (1) labor, (2) supplies, (3) power and (4) miscellaneous.

Since these items generally account for 80 to 90 percent of the total mining cost it is very important they be broken down into their smallest components.

The cost of labor can be estimated rather closely with the exception of that used on maintenance work. In figuring the required labor force, it is advisable to divide it into two classes; production labor, and "fixed" labor. Fixed labor can be broken down into five groups; (1) haulage

and hoisting, (2) shops and maintenance, (3) general inside men, (4) general outside men and (5) mine office.

In a broad sense fixed labor crews can be considered "service" groups because they are required to keep the face production crews serviced for efficient production. The number of men required in each group depends on the size of the mine and the deployment of production and development crews.

Production crews are generally set up in units to operate a production section such as a stope, set of rooms (as in trackless mining) or some other natural division within which they can work together effectively.

An analysis of the mining method, in its application to the ore body, will serve to establish realistic production quotas for each of the units under the various assumed conditions. This involves a detailed study of the processes of breaking, handling and support. The production forecasts for each of the units will then determine the total number required for the desired tonnage, taking into account ore which may come from development. The total number of production men and their job rates will then be known.

The rate of development called for in the study will determine the number and classifications of the men required for this phase of the operation.

The "fixed" labor groups are next set up so as to service efficiently the production and development crews. The haulage and supply problems must be analyzed and adequate provision made to keep production flowing smoothly. The number of shop and maintenance men required is difficult to estimate and experience is probably the best guide.

For ease in figuring the labor cost, it is usually expedient to develop a hypothetical payroll for the proposed operation. Allowance should be made for expected overtime and shift differentials. Some of the miscellaneous costs, such as payroll taxes, workmen's compensation, and a number of the fringe benefits, can also be developed on the payroll sheet. A flat percentage figure can often be applied to cover fringe items based on company practice.

Probably the most difficult estimates to make are those of supply costs. These involve hundreds of items, most of them of small unit value, which in the aggregate, make up anywhere from 30 to 60 percent of the total mining cost. A complete breakdown of the costs of supplies for a similar operating mine would be very helpful as a check list, and many of the items could be compared directly. Supply costs depend on the specific job of mining being done and, therefore, must be worked up in minute detail for every job in the mine.

Explosives, timber, drill steel and bits make up a large proportion of the supply costs in most small underground mines. In some of the larger highly mechanized operations, repair parts will be one of the major items.

Tables II and III give some idea of the consumption of explosives and timber for various mining methods. Table IV shows recent figures on the cost of drill bits and steel for various sizes of drills under varying penetration rates. The figures given in Tables II and III have been compiled from a number of different operations and show the usual ranges; however, there are undoubtedly operations which fall outside these ranges. The reader should beware of using average figures as they will probably not fit in any given case.

The explosive and drill manufacturing companies have competent men with a wide range of experience who can be called on for assistance in making estimates for a new operation.

Power used for pumping can be one of the major variables. In some mines up to 50 percent of the total mine power is used for this purpose, and it is dangerous to assume too low a figure for this part of the power load. In general, power cost can be closely approximated by using 75 percent of the estimated connected horsepower in figuring the demand charge. The energy charge can be obtained by estimating running time of electrical equipment and applying this correction against the connected load. This should be increased by from 5 to 10 percent to cover small motors, lighting, battery charging and other uses of power depending on the assumed conditions. Power cost can then be figured on the basis of the power contract offered by the utility or the cost of generating it at the mine.

Miscellaneous items account for from 10 to 20 percent of the total mining cost and include salaries, workmen's compensation, vacation pay, fringe benefits, payroll taxes, property and franchise taxes, insurance, office expense and other miscellaneous.

Salaries account for a large percentage of the total miscellaneous cost. The items of salaries, workmen's compensation, vacation pay and payroll taxes can be closely estimated from a list of the supervisory group and the payroll sheet. The other expenses would have to be estimated as closely as possible under governing conditions.

Capital Costs

The economic picture cannot be developed without an estimate of the capital costs required to bring the mine into production and for carrying on the operation—they can be developed only after fairly complete mine and plant layouts have been made for the program under study. Capital costs can be listed under three major headings: (1) Initial mine plant and equipment, (2) Preproduction development and (3) capital additions.

Initial Mine Plant and Equipment—The size of the proposed operation would dictate the size of the mine surface plant. Hoisting facilities or haulage units would be governed by the tonnage to be handled and other facilities such as change room, shops, mine office, etc., would be geared to the requirements of the mine.

At this point a complete list of specifications for all the major pieces of equipment should be drawn up. Unless the company considering the project has a complete and fully integrated engineering division, the services of contracting firms in the business of building mine plants may be called in to make preliminary estimates.

The size of the operation would also govern the selection of underground mining equipment. A detailed list of all of the equipment would be made and the cost would be determined by checking with manufacturers. Freight charges and estimated installation costs for various facilities must be added to the cost of equipment.

Pre-production development—There are reliable companies experienced in shaft sinking and development work who can be called upon to make estimates. It is often an advantage to contract shafts and the initial development work during the time of major construction. The estimated costs for development up to the time the mine is expected to go into production can then be determined.

Capital Additions—In working out the economics and cash flow, it will be necessary to know what cash outlays would have to be made from time to time. Therefore, in addition to the

usual capital cost estimates, the engineer is asked to make an estimate of additions to mine plant and equipment on an annual basis over a number of years. It is very difficult to determine what plant or equipment additions will be required in the future; however, an "educated guess" can be made which usually serves the purpose. Inflationary forces are not usually taken into account as it is reasoned that any increases would also apply to the mine's saleable product and that this would tend to balance.

Mechanization—Its Effect on Costs

During the past decade mechanization has tremendously increased the productivity of labor in non-selective methods of mining. The change has been most notable in open pit and trackless-type room and pillar mining. In open pits, new drilling equipment, such as mobile rotary rigs and down-the-hole drills, has increased drilling speeds by several hundred percent. In one pit operation rotary rigs increased the speed of drilling over churn drills by 560 percent. More efficient shovels and large off-the-road haulage units have cut handling costs almost as spectacularly. These changes have resulted in reducing costs in the face of inflation, and have made it possible to mine lower and lower grade ore economically.

The trend toward mechanization has been just as effective in mines employing trackless equipment. Because of mechanization and better utilization of labor, many of these mines have been able to absorb increase after increase in wages with little change in over-all mining costs.

A very interesting comparison of old hand work methods in room and pillar mining 30 years ago with the modern high speed trackless room and pillar mining of today is shown in figure 1. During this time the percent of labor to total cost has dropped 19 percent; the cost of labor rising only 42 percent as fast as commodity prices. "Other costs", however, are about twice commodity prices reflecting the added cost of mechanization and more supplies per unit of labor. Due to the large increase in productivity, total costs have only risen nine percent above commodity prices showing that, with the use of a high degree of mechanization, the cost of room and pillar mining has almost been kept in line with the inflationary rise.

The percentage of labor to total cost has not appreciably decreased in mines using relatively high cost selective mining methods. In fact, it has actually increased in the case of square-set mining where mechanization has been quite limited. The effects of this can be seen in figure 2. In this case labor has increased twice as fast as commodity prices whereas "other costs" are 18 percent below the index. The total cost per ton for this method of mining has gone up 58 percent above commodity prices.

Ontario Gold Mines reports that tons of ore mined and milled per wage earner at Ontario gold mines increased by 40 percent between 1935 and 1954 while annual wages rose 103 percent. The cost rise has been slowed down by mechanizing but the trend has not been reversed. Unfortunately, this seems to be true in most mines in the United States.

The case histories of mines which, by effectively mechanizing their operations, have managed to raise their productivity to keep pace with inflation, point the way toward the future. In order to be competitive in the mining industry today, one must constantly strive for high speed mining operations with a high output per man shift. New techniques and mechanization must be taken into account in selecting the mining method and laying out plans for any new mining venture.

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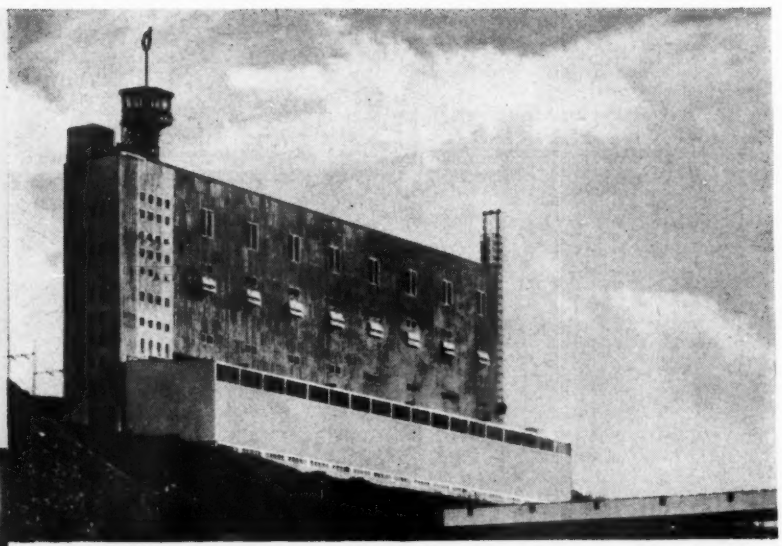

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Machine Loading Blast Holes With Ammonium Nitrate

Mechanizing the process of loading blast holes has enabled a West Virginia mine to profitably strip coal under adverse conditions

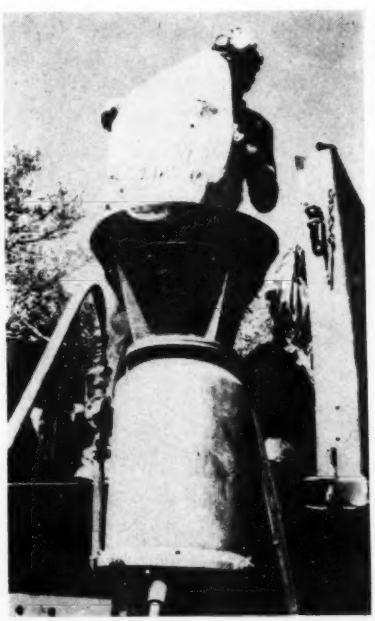
By D. S. BLOUNT
President
Raleigh Eagle Coal Co.

RALEIGH Eagle Coal Co. has been using in recent months a blasting technique which, although not perfected, has helped to make it possible for the company to remain in business. This article will spell out the company's efforts to mechanize the process of loading blast holes with ammonium nitrate, emphasizing the system's advantages and limitations.

Hill Top Stripping

First, let us consider the conditions at Raleigh Eagle. It operates a typical southern West Virginia strip mine—in mountains that are virtually up and down. Working three to five seams, the company dumps an average of 2400 tpd into a bin on the coal elevation, high on the mountain. A vibrating feeder feeds this coal into a specially designed chute which delivers the coal by gravity into a receiving bin at the foot of the mountain, 850 ft below, adjacent to a hard surface highway one mile from the cleaning plant. The distance from the dumping point on the coal elevation to the regular head house is six miles around the strip pit.

The writer looks with envy at people who are operating in level country, where you can drill either vertical or horizontal holes and carry out the steps of your blasting practices without undue complication. The steepness of the southern West Virginia hills, with sand rock cropping directly above the coal seam, makes it impossible for Raleigh Eagle to drill vertically. In most cases the slope above the operation is steeper than 45°. This, of course, makes it absolutely necessary to concentrate explosives in the back of the blast holes.



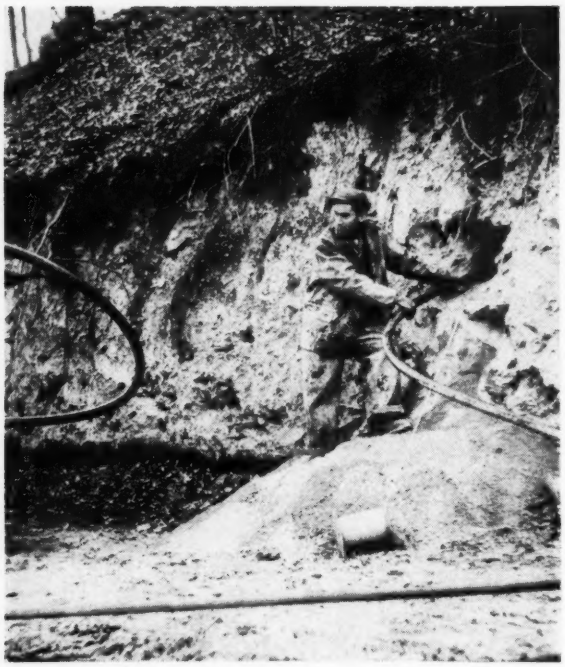
Ammonium nitrate is blown into the blast holes at the rate of one 80-lb bag in 15 seconds. Two men have loaded and fired as much as 15,000 lb of ammonium nitrate in a shift

When the company first started stripping at Ameagle, W. Va., it had no particular drilling problem because there was a seam of shale between the coal and the sandstone above which the mine wished to break. Now, however, in the area in which the company is operating, there is no shale between the sand rock and the coal, and the mine is having trouble with the conventional type of highwall drill, because the men cannot get the explosive into the rock where it is needed. So the mine has experimented with a "down-the-hole" type tool, and has found it will work. The company is having a drill rig built to handle this tool for the operation.

A visitor at Raleigh Eagle's operation today would see a bulldozer pioneering along the top coal seam, followed by a new "down-the-hole" drill, drilling seven-in. holes 40 to 60 ft into the mountain and spaced about 12 ft apart. He would also see that there is 60 to 80 ft of sand rock over the back of these holes.

Need to Shoot Hard

Management knows it couldn't stay in business on this mountain with its tough sandrock if it were not for fertilizer-grade ammonium nitrate. The company has to blast, and blast hard, every cubic yard of overburden. The powder factor is about one lb. to two yd. So, low cost ammonium



In shooting horizontal holes in steep mountain strip operations, the problem is to concentrate the blasting agent and its primer in the back of the hole where the hardest work is to be done

nitrate is essential to a profitable operation. To go a step further, it is the writer's belief that the company could not strip this coal profitably if it loaded fertilizer-grade ammonium nitrate into these horizontal holes by conventional methods. Here's why.

In shooting horizontal holes in steep mountain strippings, the problem is to concentrate the blasting agent and its primer in the back of the hole where the hardest work is to be done. You just can't do this with cartridges, no matter how hard you tamp. Secondly, the advantage of low cost fertilizer is dissipated when you have to load, or buy, cartridges and either manually or mechanically push them into the holes. Furthermore, because of the low sensitivity of fertilizer, there is always the danger in cartridge loading, or loading dimensional bags, of having air gaps or other interruptions in the explosive column, which can mean missed holes. So, if you add cartridging costs, labor costs and unsatisfactory results in horizontal hole shooting, fertilizer may not be as economical as it seems to be.

Raleigh Eagle could not break this rock so it could be dug economically if hand methods were employed in loading the blast holes. Here's what the company does instead.

Pre-oiled ammonium nitrate is purchased in 80-lb sacks. This is delivered to the operation by a local explosives distributor who has a special plant for oiling the ammonium nitrate and allowing it to age for seven days before delivery. This pre-oiled ammonium nitrate is half prilled and half granular material, and, judging from the pure white smoke of the mine's blast, the aging definitely helps the penetration of the oil and promotes complete detonation of the material. There is also some gain in density over all-prilled material. Raleigh Eagle has considered doing this oil and aging itself, but found that the investment in plant and labor could not be justified.

Load Holes With A Blow-Loader

From its storage point on the stripping operation, the company loads enough ammonium nitrate and primers for a day's shooting onto a ten-ton truck on the back of which is mounted a Jetloder. This is an ammonium nitrate blowloading machine. At the scene of the blast, the two men who handle the explosives work, park their truck and assemble a core of primer in each hole to be blasted. This is done by inserting sticks of 1½ by 12-in. high velocity gelatin into fibre tubes. Each tube is 11 ft long and these are kept in a continuous column with 12-in. sleeves. It is light work, assembling these cores and inserting them into the holes, attaching detonating fuse to the last section. This provides a continuous core of high explosives the full length of the ammonium nitrate column. Following this priming operation a small 105-cfm compressor is connected to the blow loading machine and the two men commence loading the ammonium nitrate. One man stays on the truck to handle the blow-loader and the ammonium nitrate, while the other goes from hole to hole with 100 ft of 1½-in. I.D. plastic hose. The man with the hose inserts it clear to the back of the hole and calls for air to blow out mud and water which may have accumulated since drilling. Then he signals for ammonium nitrate, and this is blown into the holes at the rate of one 80-lb bag in 15 seconds. Actually, counting the time of dumping the bag into the blow-loader and turning on the air and then blowing

(Continued on page 58)

To assemble a core of primer, sticks of 1½ by 12-in. high velocity gelatin are inserted into fibre tubes. Each tube is 11 ft long and these are kept in a continuous column with 12-in sleeves. Detonating fuse is attached to the last section

Senator McClellan Views LABOR REFORM

An address by the Distinguished Chairman of the Senate Committee to Investigate Improper Activities in Labor-Management Relations—as Presented at the Annual Convention of the American Mining Congress

By the Hon. JOHN L. McCLELLAN
U. S. Senator from Arkansas

It is a very great honor to have the esteemed privilege of addressing this magnificent audience of my fellow countrymen. I have heard for a long time that your meetings are distinguished by the fact that they are attended by large numbers of outstanding leaders who are truly representative of the mining industry and other enterprises throughout the country, and from what I have observed this morning, this occasion seems to be no exception.

I think, before this informed group, that it would be presumptuous and fruitless for me to attempt to direct my remarks to matters of special interest to you and to your segment of the economy. Therefore, I shall discuss subjects and issues that are of concern and of interest to every citizen of this country.

I should like to observe, however, that I am fully cognizant of the fact that the mining industry has had its own problems. Some of them still persist and they are vexing and difficult. But I have observed through the years that you work diligently and often successfully toward their solution through the legislative processes and through the administrative channels of our government.

We also know that minerals and metals are essential to the industrial complex of this modern age; that they are indispensable to our future peace, progress and prosperity; and that adequate sources of supply are of vital and strategic importance to our security and survival. I am advised that the annual value of the minerals produced within this country, including petroleum, is now about $16½ billion. These minerals serve as the basis for the major portion of our manufactured products. Thus, the mining industry is one of

the greatest pillars supporting and sustaining our vast economic structure.

We can expect, I am sure, that as research develops more and greater uses for minerals, your industry will undoubtedly occupy a still greater and ever-increasing position of importance in the economic life and prosperity of our nation.

Over the years mining organizations in general, and during the past few years the American Mining Congress in particular, have taken positions on major public issues and have wielded considerable influence on the course of government and the affairs of state. I have observed with approval that you have not only dealt with special problems facing the mining industry but, by appropriate resolutions and actions adopted and taken at your annual meetings, that you have supported the doctrine of States' rights; you have strongly advocated the principle that the Federal Government should only do for the people that which the people are unable to do for themselves; and you have consistently supported greater efficiency and economy in government—and the Lord knows that's needed—and you have strongly endorsed and urged the enactment of effective reform legislation in the field of labor-management relations.

In these activities, and in the doing of these things, you have made and you are making constructive and valuable contributions to our country's progress, to its security, and to its welfare. I am happy and pleased to have this opportunity to publicly commend you and to express my appreciation, not only as an American citizen but as a member of the United States Congress, for the splendid record your organization has made and for the excellent services that it has rendered.

You, I know, like most good citizens throughout the country, must be at least reasonably well pleased and gratified with the recently enacted new labor law. That measure, beyond all question, represents the major legislative product of the first session of the 86th Congress. No other bill considered or passed is of greater magnitude, of more vital importance, or was more urgently needed. And none will have more far-reaching consequences and impact on the social, political, and economic life of our nation.

Approval of the Labor Reform Act of 1959 is a long stride taken toward cleaning up corruption, eliminating abuses, and preventing many of the exploitations that have been practiced and imposed by some labor organizations throughout this country. The enactment of this measure is a striking victory for honest working people, for decency and integrity in unionism, and for the welfare of the general public at large.

Its passage, however, is a victory that was hard won. The final results were by no means easily attained. It took two and a half years of intensive and thorough investigations by the Senate Select Committee with a large, competent, and efficient staff, and at a cost of some $2 million, to bring to light the sordid, shameful, and intolerable conditions that existed in some areas of labor-management relations. Even after these startling exposures were made and the necessity for strong and corrective legislation had been definitely established, the Congress for a long, long time approached the issue timidly, haltingly, and without determination and firmness of purpose.

You know the struggle that went into securing this legislation. Last year, in the last Congress, there wasn't any great enthusiasm about it. It was more of a political issue in the last session than it was a genuine effort to legislate to correct these conditions. But that situation began to change with the 86th Congress. We noticed that much uncertainty prevailed, however, throughout its two years of deliberations as to whether—and there was doubt at times—the Congress would really face up and measure up to its duty and enact the laws that were needed to correct these conditions.

In the meantime, professional lobbyists on both sides of the issues were plying their trade and applying great pressure in their attempts to influence the result. But, finally, it was the voice of the people that made itself heard and made the balance of power. It was a deciding factor when the people spoke out in no uncertain terms to the members of Congress and let them know they not only expected but demanded adequate reform legislation. So the people won over the opposition and over the lobbyists and over those who wanted a soft bill or no bill at all, and over those who, in my judgment, wanted just a moderate bill. There were those, possibly a little extreme, who wanted much stronger legislation than was finally enacted.

The public had been shocked to the extreme by the ugly and frightening revelations made by the Select Committee, and its righteous indignation rose steadily as the Rackets Committee made more and more alarming disclosures, and as it continued to hold public hearings it was evident that it would finally explode and the public would prevail. So it is a source to me at least of deep gratification, and I know it must also be to you, that the Congress did, in the final test, substantially meet the responsibilities that rested upon it.

I hardly think, however, that anyone will contend that this law will necessarily stop all wrongdoing and prevent a recurrence of all the improper practices that have been revealed. Surely it is not perfect. I could take a pencil and make some interlineations in the Act and scratch out a word or two here and there and make it a stronger bill and a more perfect measure according to my interpretation of the needs of the hour. Nevertheless, it is a bill that will be effective. In the course of our experience with it, in the administration and application of it, we no doubt will find it contains some deficiencies. But if its terms and provisions are correctly interpreted—get that, *correctly interpreted*—applied and administered in accordance with the will and the intent of the Congress, this law will definitely make the way hard for the crooks and the corruptionists and the transgressors. They will no longer be able to commit flagrant abuses of power and betrayals of trust with arrogance and impunity as they have been doing in the past. They simply will not be able to get away with it. Such reprehensible conduct hereafter will cause, in my opinion, their downfall and doubtless the overthrow of their power.

But I may warn you that this notable victory we have achieved in the passing of this law must be preserved. The foes of this legislation have by no means been rendered impotent. They are still militantly active in their opposition to it, and we can expect every effort from them to hinder its enforcement, to impair its effectiveness, and to discredit its probity. They can be expected to make unrelenting attacks on it. They will try to prejudice the public and inflame union members against it by the use of phony slogans and labels against it.

They will rail out against it with charges that it is a "killer" measure, that it is "union-busting," that it is "antilabor,"—the same old time-worn phrases that they have used heretofore whenever any effort was made to legislate in this field in the interest of the general public.

Well, it is anti; it's got a lot of anti things in it. Let me tell you what some

of the anti's are. It is anti-gangster, goon, racketeer, and hoodlum; it is anti-theft, embezzlement, shakedown, blackmail, and extortion; it is anti-arson, acid assault, vandalism; it is anti-fraud, dishonesty, crookedness, and corruption; it is anti- violence, bestiality, brutality, and cruelty; it is anti-dictatorship; it is anti-boss rule; it is anti-oppression; and anti-exploitation. Yes, it is anti these two dozen things and many more. When they are properly summed up, it is established conclusively and irrefutably that this law, if enforced, will be effective in preventing crime, tyranny, and exploitation from being imposed and inflicted upon American workers both in unions and without, and upon businesses, and upon the public generally.

But this law is not only anti some things; it is pro many things as well. To enumerate some of the pro's, they may be described as certain rights that the law procures and protects for union members. Some of them are: The right to equal treatment, to speak freely and to assemble freely; the right to invoke the protection of the laws, to be free from arbitrary and unfair union discipline, and to be free from threats or acts of violence; the right to participate in the nomination of union officers, to participate in the deliberations regarding union business, and to vote in elections, by secret ballot, for union officials; the right to control the use of union funds, to inspect records, and to receive copies of collective bargaining agreements; and, above all, the right not to be harmed by other peoples labor disputes, to appeal for redress of grievances, and to be free from domination by convicted criminals, crooks and Communists.

It is the Bill of Rights provision to which I have referred. It is the Bill of Rights provision in Title I, and the secondary boycott, organizational picketing, hot cargo contracts, and the elimination of the no-man's land provision in Title VII that the labor bosses most seriously object to and protest against.

With reference to these, they contend that the law is punitive; that it is vindictive, repressive, and restrictive. But I can say to you that such charges are not tenable because they are not sustained by either the facts or the record. The provisions in these titles relating to these subjects, I submit, are not punitive—they are protective. They are not vindictive—they are vindicative. They are not repressive—they are progressive. They are not restrictive—they are restraining

"Approval of the Labor Reform Act of 1959 is a long stride taken toward cleaning up corruption, eliminating abuses, and preventing many of the exploitations that have been practiced and imposed by some labor organizations throughout this country"
Courtesy Associated Press Photos

and constructive measures for the establishment of justice, freedom, and equality in labor-management relations under law.

The claim by labor bosses that the Bill of Rights provision for the rank-and-file dues-paying union members is not needed is completely refuted and put to shame by the multitudinous instances of vandalism, intimidation, personal abuses, acts of physical violence, threats of bodily harm, and denial of basic human rights of union members as revealed in volumes of recorded evidence before the Senate Select Committee.

To me, these activities that I have enumerated constitute the most vicious evil of all that the Senate Select Committee exposed, and I take some personal pride in having authored the Bill of Rights title that is now incorporated in this new legislation. You couldn't sit on the committe for 270 days, hear 1,525 witnesses testify, make a record of more than 45,000 pages of transcript, watch with disgust and a sickening sensation 343 Fifth Amendment artists and experts parade before you, taking shelter under the Fifth Amendment in an effort to keep the truth from coming to light, and hear the stories of what goes on in some union meetings without determining to work for effective legislation. I am not talking about all unions. I am not indicting all organized labor. I am talking about those that we investigated. This committee was charged not to go out and interfere with the business affairs of good unions, but to find those that were guilty of improper practices, make an investigation thereof, and report to the Congress. We found in those that we investigated conditions that are unbelievable and intolerable in a country of free peoples.

A bill of rights was needed. No bill would begin to reach the problems that exist today except that the individual members are given their rights under the Constitution. We have given the members now in the Bill of Rights tools with which they can work and which they have not had in the past. It's been not only disconcerting, it's been not only frustrating, but it's been most discouraging to many of them when they went to their union meetings and found that they could not exercise their rights as free men and as dues-paying members, found that they were oppressed and all their efforts to get right and justice done were suppressed and overridden by dictatorial authorities. We have now given them some rights.

I want you to do this: Bear in mind that there is nothing in the union workingman's Bill of Rights that is not based on, and that does not conform to, the civil liberties and personal freedoms contained in the Bill of Rights of the Federal Constitution. We have found that these rights, as I have just pointed out, have been denied to many workers, and I say that if a union member cannot attend meetings, speak freely, oppose and criticize union policies and officers without reprisals, then he is not a free man. I would ask, "Why should any citizen of this great country of ours be compelled to leave the rights and freedoms and the protections guaranteed to him by the Federal Constitution on the outside of the union hall when he enters it—any union, anywhere, and any time? Why shouldn't these rights and protections that he enjoys as an American citizen continue to serve and attend him when he is in the union meeting?"

Unions exercise extraordinary powers of industrial government, encouraged and protected by Federal law. It is therefore entirely appropriate—indeed it is vitally essential—that the Federal Government insure

that these governmental powers over union members are not abused, but that they are exercised fairly, honestly, and democratically. These basic human rights to all of our citizens are sacred, and no labor boss or dictator of a union, or of any other organization, should be permitted to violate or take them away from any member of such an organization or from any citizen of our country with impunity.

The Bill of Rights in the new labor law is truly a Magna Carta for the rank-and-file union members of this country. It is an emancipation provision. Its principles and philosophy are now embodied in the national labor policy of this country by the law of the land. This assures a new day of freedom for the working men and women of America.

The secondary boycott, organizational picketing, hot cargo contracts, and no-man's land provisions of Title VII, in my judgment, are indispensably essential to the protection of what we may term innocent bystanders, to small business, and to the public at large in labor-management disputes. They are necessary to prevent certain types of economic coercion and abuses of power that have heretofore been imposed and that should no longer be tolerated in our government or in a free society.

I have been asked—and I know you ask yourselves—if this law is going to be adequate to deal with a Hoffa-type union operation. The answer is "Yes." It will deal effectively with many aspects of corruption, abuses and exploitations that exist in the Teamsters Union. But I have repeatedly expressed apprehension regarding certain grandiose plans of Mr. Hoffa, with the cooperation of Harry Bridges and others, to form some kind of an over-all federation or association of all the unions in the transportation industry. Such an organization would possess tremendous powers and have such control as would endanger the economic freedom and security of our country. Mr. Hoffa had made threats, certainly implied if not specifically, if legislation is passed not according to his liking—and I don't see how he can like what we have enacted. He has made his threats. Whether he will go through with them or not, I don't know.

But if this law proves insufficient to stop the developing and organizing of a combination of transportation unions in restraint of trade, to repose in such an organization a power that will enable a Hoffa at his whim or a Bridges at his whine to stagnate the commerce of this country, to cause the wheels of industry to stand still, to exercise powers that are not reposed in the government itself, to set up a supergovernment, to control and dominate the economy of this country, I say if any such thing is attempted—and it's in progress if this law may not be sufficient—what is the answer? There's only one alternative. Some of us don't want to go that far, but there's only one alternative. That's to put the transportation unions in the country under the antitrust laws. Hoffa or no one else must be permitted to rise above the power and beyond the reach of the government itself.

In conclusion, I may say it takes some courage on the part of your Congressmen and your Senators to face up to their responsibility in the conditions that prevailed as they were associated with this legislation. I pointed out the efforts, the lobbying that was carried on, the pressure that was applied. Back of it all, during that time and subsequently since the bill was passed, the threats have been expressed publicly and openly. Back of it all was the implied threat of Hoffa of reprisals if your Congressman and Senator didn't do the bidding of those who opposed the "right kind of legislation."

Businessmen sometimes think it is easy for a member of Congress to simply go out and be a statesman and do his duty. You devote your lives to a business. You give it your energy, your time, your strength, your talents in competition in a free society, and you succeed. You take pride in that accomplishment, and well you may. The average Congressman and Senator have devoted their lives to public service. Their success in politics can only continue by the will of the people. It's not easy to face up to threats. It often takes courage to do it. And if it is ever written for the permanent record with respect to this Congress, I think it can be said that, under the most trying conditions, on this issue it rose to the occasion to have the courage, in the face of the threats of these reprisals and political destruction, to do its duty.

That duty having been done, I foresee in America a better day for the working men of this country, both in unions and without. I foresee a greater day in America for honest, decent unionism. I hope, however, the day is darker ahead for the crooks and the thugs and the gangsters and racketeers that have shamlessly and shamefully exploited and oppressed many of the working people of our country.

AMMONIUM NITRATE

(*Continued from page 54*)

the machine empty, it takes about one minute per bag. The mine uses about 240 lb per hole so that means about three minutes per hole in actual loading.

The material is blown with 40 to 50 lb of air pressure and packs solidly into the back of the hole—almost like concrete. The company finds it can get a third again as much blown material into a given length of bore hole as it can with cartridged material.

About one minute is spent from hole to hole in withdrawing the hose and inserting it. The two men have no trouble at all in keeping up to schedule, and they have loaded and fired as much as 15,000 lb in a shift.

Loading Process Not Fully Mechanized

As previously mentioned, the loading process is not yet fully mechanized. The company still uses hand-filled tamping bags and the two men spend too much of their time in filling and ramming these bags into the blast holes with a jointed tamping pole. Although the blow-loading machine will also blow sand, management hasn't determined yet that it would be profitable to haul sand up the mountain, seeing that there are drill cuttings ready and waiting at the mouth of each hole. Experiments are planned in blowing these drill cuttings to determine the feasibility of this idea.

When the blow-loader was first introduced, the men at Raleigh Eagle were somewhat suspicious of it, but after eight months of operation they acknowledged that it has made their job easier and more productive and have accepted it as just another new piece of machinery.

As the writer visualizes it, this is just a first step toward mechanization of the loading process. As he has told the company's powder distributor, there is no reason why the distributor should not bring the material out in bulk and blow it into the holes for the coal company in one quick, efficient operation—or, if Raleigh Eagle were bigger, why it should not employ bulk handling methods itself. It's just one more step toward modernization, and just as the company can't afford six men with picks and hand shovels to mine coal, it and many other operations can't afford a primitive hand gang pushing a tamping pole.

Should a company overhaul its own equipment or should it utilize the services of outside specialists?

Overhauling Mining Equipment

By W. R. WOOD
Electrical Superintendent

and

P. C. STULL
Supervisor of Maintenance—
Underground Machinery
The Berwind-White Coal Mining Co.

DURING the past several years the coal mining industry has gone through an era of mechanization in an attempt to keep in a competitive position with other fuels. As a consequence, we find today a system of concentrated mining utilizing large, expensive machinery with high productive capability. To keep these machines efficiently productive is the whole object of any maintenance program. This article describes how the Berwind-White Coal Mining Co. is developing its overhaul program to contribute to this end.

The mines under discussion are owned and operated by Berwind-White and are located in Cambria County in the Central Pennsylvania Bituminous District. At present two mines are in operation with a combined capacity of about 10,000 tpd. One is a drift mine and the other a shaft mine. They are about 12 miles apart.

Major items of equipment in service include: 3 Jeffrey Colmols, 4 Joy 3JCM4's, 1 Joy 5CM, 26 loading machines, 40 shuttle cars, and 13 arc wall cutting machines, together with associated belts, car spotters and other equipment. Haulage is by electric locomotives. Power is supplied by a 550-volt d-c grounded return system and serves all purposes in the mine.

Before the advent of modern mechanized mining, most repair work was done in the mine at the working face. When cutting machines, pumps, and other equipment were worn out or broken, they were hauled out to a company-owned central machine shop where repairs were made. Electric motors and armatures were rebuilt in a company-owned armature repair shop near the machine shop.

Mechanization Brings Need for Overhaul Facilities

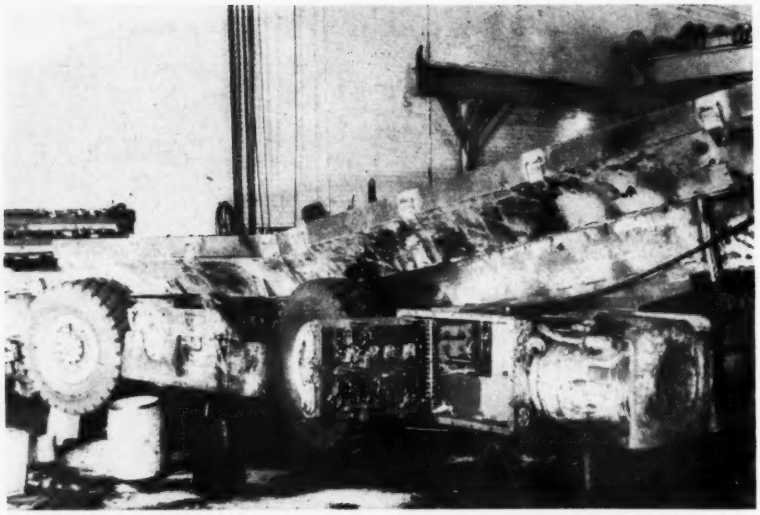
When continuous mining machines, loaders and shuttle cars came into the picture, some new plan of overhaul and repair had to be developed. After a time of make-shift, the company decided to fix up a place for this work in an old brick power house near one of the mines.

This building was already equipped with a 15-ton hand-operated traveling bridge crane; so by adding work benches, a drill press, electric welder, grinding wheel, hand tools and lighting, repairs and overhauls could be done here. At that time this shop was set up only to get along for a while to gain experience. As time went on, additional facilities were added until today the shop equipment includes a motorized jib crane for serving a truck dock, two electric welding machines, a solvent tank for cleaning bearings and small parts, a steam cleaner, two drill presses, three grinders, air powered impact wrenches, hand grinders and a kit of small tools for each mechanic. An area has been set up with an overhead bridge crane with clearance under the main crane. This area is equipped so that any item of mining equipment can be disassembled and overhauled without interfering with the use of the main crane. With this arrangement a Colmol and two other major machines can be overhauled at the same time.

A room has been constructed in the shop for electrical panel rebuilding. Another room is equipped for tire repair and water filling.

In conjunction with the shop, a supply room has been built. It is used for regularly required replacement parts for the mechanized mining equipment only; other mine supplies are stored at another location.

Work force is made up of skilled mechanics, most of whom have had several years experience in the mine.



Every part is checked for wear and physical damage. The whole object of any mine maintenance program is to keep equipment efficiently productive, and Berwind-White Coal Mining Co. has kept this in mind in developing its overhaul program

In addition, one man makes deliveries and pick-ups with a small truck and assists in the supply room. Another man keeps machine records and attends to supply requisitions.

The original machine shop and armature shop are continued in service. These shops are well equipped and perform a very useful function in routine repair work and especially in taking care of emergency work. Very often parts can be made that save hours and days of down-time of important equipment.

Spare Units Essential

Plans are being developed to make some changes in the machine shop to provide means for efficient reconditioning of components such as wheel units for shuttle cars, speed reducers, clutch assemblies, and other unit parts. It is believed that this plan will materially improve the service performance of these parts and aid in relieving the load on the overhaul shop.

A rebuild job should be done according to good machine shop practice; this means that all components must be assembled with shafts, gears, and bearings fitted to correct tolerances and in accordance with manufacturers' specifications. This procedure requires that all components be taken to the machine shop where qualified machinists can remachine welded parts and reassemble the component to the equivalent of new. The complete component can then be stored at the overhaul shop for use as needed.

During the first few years of mechanized mining, the company often found itself with an idle machine for lack of spare unit parts or components. At that time every item of mining equipment was in active productive service so that no spares were available, consequently repair jobs either in the mine or at the shop were rushed through without doing more than necessary. This situation soon became intolerable and steps were taken to provide essential spare units. Spare components that the company considers essential include electric motors, control panels, hydraulic pumps and motors, wheel units for shuttle cars and a complete ripper head for the 3JCM-4 miner.

Production Records of Machines Pinpoint Cause of Delays

For several years management has kept a card file record of each major machine in the mine, keeping track of tons of coal mined, major repairs and other information. From past experience the company has found it to be highly desirable to keep more complete data in relation to the service and performance of each machine. During the past couple of years the production record of each machine has been kept with a breakdown of delay time at the face into four general categories, i.e. electrical, mechanical, hydraulic and operational. By reference to these data, it is possible to pinpoint the cause of the delays and to take remedial measures. At present, management is attempting to evaluate the efficiency of its maintenance and overhaul program by reference to this information.

As more data is obtained, the company expects to establish a practical schedule for overhaul jobs. At this time the company believes that, with one cutting head change in the mine, a Joy 3JCM-4 can be expected to mine about 200,000 tons before complete overhaul. The Colmol also seems to be ready for complete overhaul at about the same tonnage. In general, it is planned to have each major item of equipment in the shop for overhaul during the next two years. Times for overhaul will be modified by performance and in-the-mine inspection.

Complete Overhaul is Stressed

In accordance with the planned overhaul program and as carried out over the past year, an overhaul job is a complete overhaul. The machine is completely disassembled, and component parts likewise. Every part is checked for wear and physical damage. The maintenance supervisor decides how each part shall be restored to condition equivalent to new so far as serviceability is concerned. Frames and structural members are checked for alignment and wear.

Electric control panels are completely disassembled. All parts are thoroughly cleaned, using solvents and wire brush where necessary. Overload relays are checked and tested at proper load, panels are painted with an insulating enamel which has proved effective in reducing surface leakage, all worn or corroded parts are replaced, new wire is used and the panel reassembled and completely tested.

Unit parts such as wheel units are assigned either to a mechanic at the overhaul shop or, as is now planned, to the machine shop. Control panels go to the panel repair room, motors to the armature shop and if outside shop work is indicated, arrangements are made to have this done.

Shop and Mining Department Cooperate

Many times alterations are suggested by the mining department. These suggestions are discussed and often incorporated in the repair work. As an example, these suggested alterations and improvements are being built into a Joy 5CM now in the shop:

1. Change hoses—over top in chanel—use pipe
2. Relocate headlights—put on channel
3. Install large timber jacks
4. Install larger pump to speed up tramming
5. Install seat for operator
6. Change sprays
7. Reinforce undercarriage of back conveyor
8. Change tramming handle
9. Raise machine for more bottom clearance
10. Install wider flex-boards
11. Cover indicator
12. Relocate boom jacks

Note that all of these alterations, additions and changes to suit the de-

sires of the mining department require personal discussion and planning between the shop and the operating personnel. This matter is readily accomplished at the company's central shop and ordinarily includes daily contact between the parties involved.

Training Program for Mechanics Includes Classroom Instruction

One of the important factors in keeping a mining machine productive in the mine is that the person responsible for the operation and maintenance of the machine shall be familiar with the construction and function of all parts of the machine. So that minor repairs and adjustments as well as effects of improper lubrication, daily maintenance and operating procedures can be better understood, at least one mechanic, who will be with the machine in service, is assigned to assist in dismantling and reassembling the major units of mining equipment. By this means the company hopes to ultimately greatly improve the operational efficiency of the mining equipment.

Over the years the company has provided training for the mine mechanics. In years gone by this took the form of strictly practical job training in electric motor and manual control maintenance. With the advent of magnetic controls and hydraulic equipped machines, it has been necessary to augment shop training with classroom instruction covering electric wiring diagrams, and hydraulic circuit functions and diagrams as well as other details. This phase of training is now being carried out by the mechanical foreman at each mine, supplemented by visits to the central shop when pertinent items of equipment are disassembled for overhaul.

Specific Examples Illustrate Costs of Overhaul Jobs

Perhaps the economic factor is most important in the operation of a mine repair shop. A few examples taken at random show costs of overhaul jobs as follows:

Item 1—Colmol No. 101 was overhauled during June and July, 1958. Labor was $3,000 and material $17,200—for a total of $20,200. This includes an item of $10,969, covering the costs of rebuilding both the upper and lower cutting heads by an outside contracting shop.

Item 2—Colmol No. 109 was overhauled in April 1959. Labor was $4,000 and material $8,500—for a total of $12,500. The labor cost on this machine includes a considerable amount due to alterations considered desirable from past experience in the mine. Not included is a new cutting head which was installed to provide more height.

Supply room is used for regularly required replacement parts. The company has also found it advisable to keep on hand such spare components as electric motors, control panels, hydraulic pumps and motors, wheel units for shuttle cars and a complete ripper head for the 3JCM-4 miner

Item 3—Three Joy 14BU loaders were overhauled during the past year. Average cost per machine was labor, $1,500; material $1,700, or a total of $3,200. The foregoing costs do not include shop overhead.

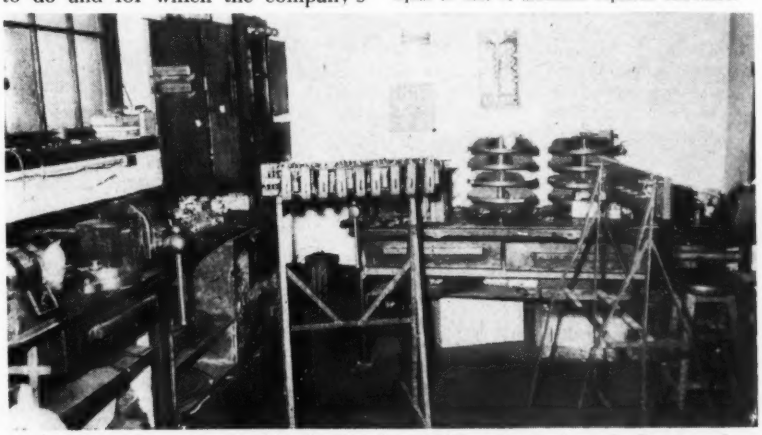
After due consideration of all costs chargeable to the overhaul shop, Berwind-White found its overhaul costs somewhat less than could be had from outside shops for comparable jobs—besides saving considerable travel time and the expense of conferences and inspections at the contracting shop. This desirable situation may not be realized by other mine shops due to amount of overhaul work to be done, location or other factors.

It should be noted that the favorable costs indicated do not include those jobs for which outside contracting shops are especially well equipped to do and for which the company's own shop lacks proper machine tools or extraordinary skills.

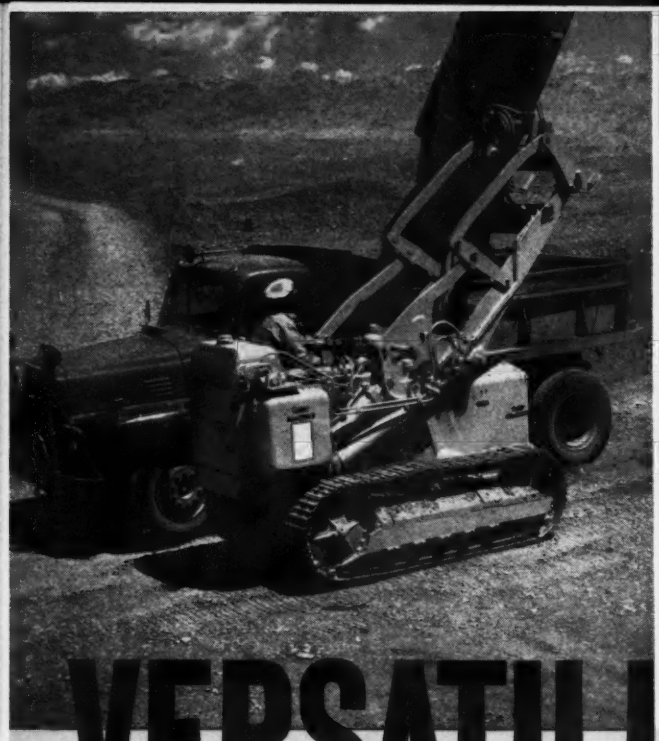
Advantages of Doing Own Work Listed

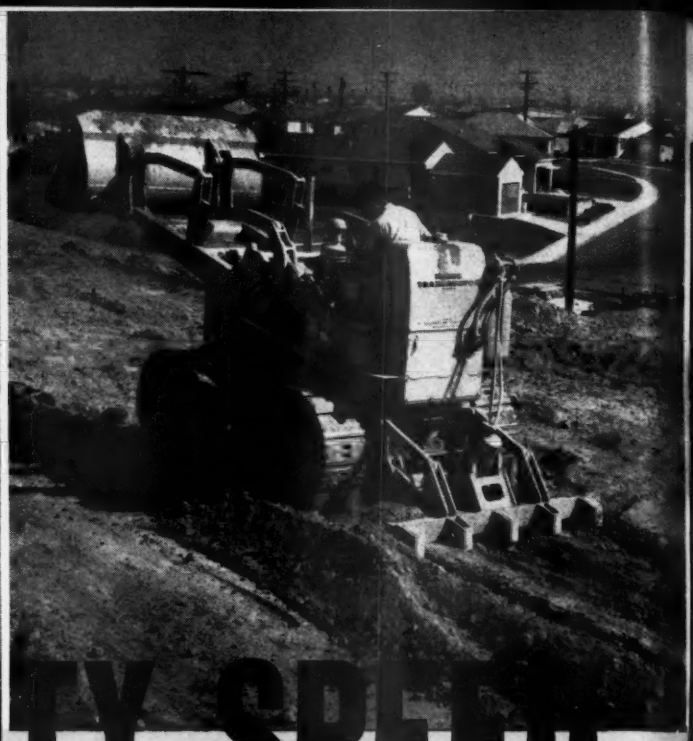
In conclusion, Berwind-White feels that its central overhaul shop has been successful and economical. The company has had these advantages as compared to sending the equipment to outside shops:

1. Repairs are made under direct supervision of a person familiar with special requirements.
2. Mechanics doing the job have a personal responsibility and interest in the final performance of the machine in the mine.
3. Decisions to reuse, replace or repair any parts can be made without delay.
4. Scheduling overhaul jobs is more readily done than could be accomplished at outside shops.
5. Evidence of neglect or abuse can be pointed out to the responsible parties and corrective instruction can be given on the spot.
6. As an adjunct to training, the shop serves a useful purpose.
7. Alterations can readily be made to meet special requirements of the operating department.
8. Past experience indicates that the company's shop overhaul performance has been equal to that of machines repaired elsewhere.



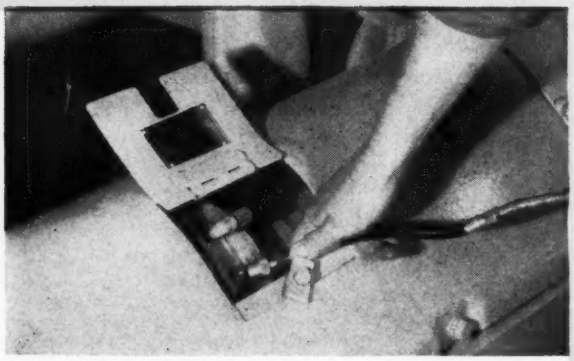
A room has been constructed in the shop for rebuilding electrical panels. Repair work includes painting panels with an insulating enamel to reduce surface leakage



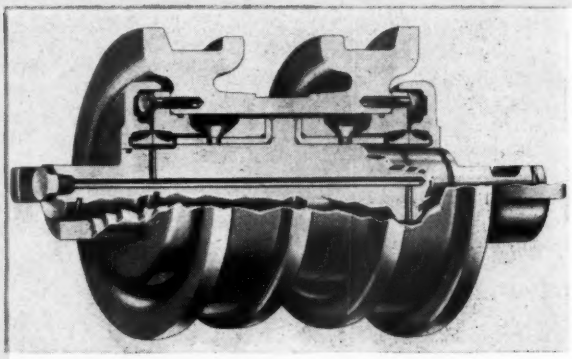


VERSATILITY SPEED

ADD UP TO TOP PRODUCTION

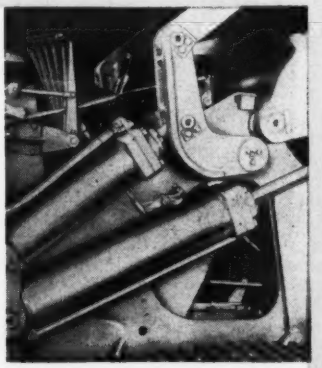


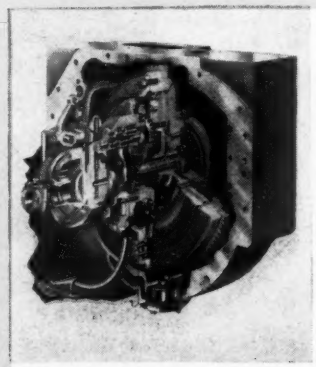
HYDRAULIC TRACK ADJUSTERS standard on the No. 977 and No. 955 —optional on the No. 933. An ordinary grease gun is all that's needed to adjust tracks. Just open the inspection door and apply a few strokes. The hydraulic cylinder does the rest.



LIFETIME LUBRICATED ROLLERS. They need no lubrication servicing until rebuilding. Heat-dissipating oil lubricant is retained by dirtproof floating-ring seal. Eliminate on-the-job roller lubrication. Keep machines on-the-go for longer periods of time.

SMOOTH-FLOW BUCKET CONTROL LEVER. The inside lever is pulled back, lifting the load. It locks in this position until it is kicked out at maximum height by the lift cylinder and linkage. After dumping, both levers are pushed forward. The bucket lowers but only tilts back to an adjustable, preset digging position. Linkage then kicks the outside lever, stopping the bucket tilt.





EXCLUSIVE CATERPILLAR OIL CLUTCH . . . the most advanced clutch design ever offered. Provides up to 2,000 hours without adjustment. This is equal to about 12 months of "adjustment-free" operation. And because wear rate of clutch facing is so slight, down time for clutch repair is almost eliminated.

DEPENDABILITY

IN A TRAXCAVATOR

WHATEVER THE JOB . . . whatever the conditions . . . there's a Caterpillar-built Traxcavator to take charge. Advance design has given this machine a reputation for speed . . . efficiency . . . low operating and maintenance costs. For this is a digging and loading tool; not a tractor attachment.

The line is complete. You get top production from three Traxcavators . . . the No. 933—52 HP, 1⅛ cu. yd. bucket; the No. 955—70 HP, 1½ cu. yd. bucket; the No. 977—100 HP, 2¼ cu. yd. bucket. And there's a complete range of quick-change attachments . . . special buckets, bulldozers, forks, the exclusive side dump bucket and the rear-mounted ripper.

Traxcavators are built to last. They have a heavy steel main frame, welded into a one-piece unit. Box construction track roller frame absorbs the loads and stresses of tough treatment. Lift arms are made to stand up under the strain of heaviest digging conditions.

Traxcavators give you fast action and ease of operation. Excellent stability and balance give better control of the machine. A fast hydraulic system cuts cycle time and increases maneuverability even in close quarters. Visibility is excellent. The high seat puts the operator on "top" of the work. Operator's compartment is uncluttered. Tractor controls are conveniently located for handling ease. Bucket controls are at the right armrest . . . closely spaced for dual operation with one hand.

The reliable Caterpillar Diesel Engine has a fuel-saving injection system and ability for hard lugging. Each engine is matched to the machine for power and bucket size.

All of these features pay off in top production. Let your Caterpillar Dealer help you choose the Traxcavator best suited for your job. Get production facts and figures. And ask for a demonstration.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR

BOOST PRODUCTION AND LOWER COSTS WITH A VERSATILE TRAXCAVATOR

AUTOMATION at the ANACONDA MILL

By JOHN R. MOORE
Assistant General Superintendent
Anaconda Reduction Department
The Anaconda Co.

In expanding capacity from 12,000 to 38,000 tpd, various process control devices were installed to increase efficiency and decrease costs

BUTTE has historically been a producer of high grade copper ore which was formerly treated in a 12,000 tpd concentrator at Anaconda. In 1952 the Kelley mine started block caving 12,000 tpd of 1.25 percent copper ore, and late in 1955 the Berkeley pit came in with 25,000 tpd of 0.90 percent copper ore. This increased tonnage necessitated the construction of the East Anaconda crushing plant, and a general expansion of the grinding and flotation capacity of the concentrator from 12,000 to 38,000 tpd.

Lower grade ores and the steady rise in labor rates resulted in increasing milling costs, and brought about a long range study of automation and process control for this operation. An instrument division was set up in the company research department in 1956 to promote and maintain automatic control of processes at the Anaconda reduction department. Following are descriptions of some of the automatic processes developed by this department for the Anaconda concentrator.

Three Ores Blended On Conveyor

At the East Anaconda crushing plant, ore is dumped in a two-car dumper at a rate of 2800 tph, two-stage crushed to one in. and is conveyed by shuttle conveyor to six 3500-ton cylindrical cone bottom bins. Three types of copper ore are crushed and each type is weighed on a conveyor scale and stored in separate bins. Variable speed feeders under the bins are used to blend the three ores as they are drawn, and the resulting mixture is conveyed one mile to the concentrator bins. Zinc and manganese ores are also crushed in this plant and sent directly to the concentrator bins, by-passing the East Anaconda surge bins.

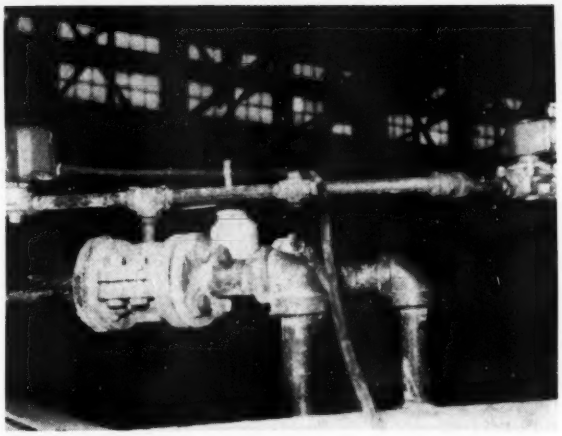
The functions of the storage operation are under the direction of a "dispatcher" who is situated in an elevated tower overlooking the car dumper and railroad yards. A central control panel in the tower shows the operator what equipment is operating, the position of the shuttle conveyor with respect to the bins, and the amount of ore in each bin. There are also controls for starting the belts and positioning the shuttle belt. The dispatcher must order the proper number of cars of each type of ore spotted on the dumper tracks. From his vantage point he can overlook the yard, and with the panel showing how much ore each bin will hold he can make the proper orders.

Transist-O-Trol probes, which are used to indicate bin levels and junction point chokes, are the heart of the storage operation. These probes are very rugged and can be made from any metal object that will conduct 25 v, such as a chain, a cable, a rod, or a pipe. When a probe contacts a few inches of ore, an electric signal is made which can be converted into any desired function. At Anaconda, chain probes are hung in each bin to measure empty, one quarter full, half full, three-quarters full or full bins and this information is indicated graphically by small lights on the tower panel. The position of the discharge point of the shuttle conveyor is also shown graphically by small panel lights.

Shuttle Belt Interlocked With Selector Switch

Surge bins at Anaconda are numbered one thru six from west to east and the reversible shuttle runs in a westerly direction to fill No. 1, 2, or

A remotely operated shuttle conveyor services the six 3500-ton storage bins at the East Anaconda Crushing plant. A control panel indicates where the shuttle conveyor is discharging and amount of ore in each bin



Adjustable timers and solenoid valves regulate operation of Red Jacket valves feeding milk of lime slurry to the grinding mills

3 bins with Berkeley pit ore and runs in an easterly direction to fill No. 4 or 5 bin with Kelley ore or No. 6 bin with high-grade underground ore. The dispatcher selects, by means of a selector switch, the type of ore he is going to run. The shuttle belt will now start only if the belt is positioned over the proper bins. For example. if he has selected to run Kelley ore which must go into No. 4 or 5 bins and the shuttle is positioned over any of the other bins, the belt will not start until it has been moved to the No. 4 or 5 bin.

When a bin is being filled and the ore reaches the "full bin" probe, a signal is sounded in addition to the visual signal given on the panel, and the shuttle is then moved by the dispatcher to the next bin. There is an emergency probe on the end shuttle belt which will stop the whole belt system if the shuttle is not moved soon enough.

It is necessary to reverse the shuttle belt when changing from bins No. 1, 2, or 3 to bins No. 4, 5, or 6 and there must be no ore feeding onto the shuttle belt when this reversal is made. A belt scale is located directly behind the head pulley of the belt feeding the shuttle with a rate indicator and tonnage totalizer located on the tower panel. The scale is connected into the shuttle reversing circuit so that the belt cannot be reversed while there is a load on the feed belt. This eliminates the possibility of a choke in this junction which could cause severe belt damage.

The second phase of the ore handling system is the conveying of a blend of ores from the surge bins one mile to the mill, where the ore is distributed by a second shuttle belt to seventeen 1000 ton cylindrical cone bottom concentrator bins. This operation is controlled by a dispatcher through a control panel located in the center of the mill and above the ore bins. Operation of six feeders, six conveyor belts, and the shuttle belt are controlled at the panel. Small panel lights indicate which feeders and belts are operating, the position of the shuttle with respect to the bins, and the depth of ore in the bins. All junction points are equipped with probes to stop the conveyor system if a choke should occur. Emergency stops are indicated by amber lights on the panel showing the location of the choke. A belt scale on the belt feeding the shuttle is tied into the shuttle reversing circuit in the same manner as the shuttle on the surge bins.

Each surge bin and mill bin is equipped with four so called "shot guns" which admit a blast of 90 psi air into the conical bottom of the bin about eight ft above the feeder belt. Usually two or three blasts will release any hang-up of ore and make the bins 100 percent drawable.

The low level probe in each bin is connected so that if a low is developed, the warning light is not turned on, but instead the shot guns are blasted three times, which will usually bring down ore. If the probe is still out of ore after the third blast, the feeder belt on the bin is stopped. This leaves the feeder full of ore and eliminates a dust condition which develops when a bin is filled on a completely empty feeder.

Seven Circuit Scanners Aid Operators

An interesting aspect of this control system is the use of circuit scanners to electrically relay process control information between the field and the control panels. Circuit scanners consist of transmitter and receiver units each containing 36 reed switches arranged in a circle—a synchronous motor rotates a magnet at 30 rpm past these reed switches.

When a process function switch is closed, a 48 v d-c pulse is sent over a pair of wires from the transmitter to the receiver where a paired reed switch is simultaneously closed. To assure both motors are synchronized, the receiver sends a reverse voltage over the same wire when the number 36 reed switch position is passed. If the units are not synchronized, a d-c breaking voltage is applied to the coils of the transmitter motor automatically re-synchronizing the system. It is possible to send 34 functions over one pair of wires which is quite important when controlling a large number of functions over long distances. The control system at Anaconda makes use of seven pairs of circuit scanners between the field and the control panels.

Ore from the company's underground mines contains considerable wood which used to cause chokes in the rod mill feed chutes and a lot of spills. Transist-O-Trol probes were placed in each of the seventeen rod mill feed chutes. Now when a choke occurs the probe is contacted, which stops the feed belt and prevents a spill. A horn signal and light indicate the choke to the rod mill man who can free the chute and start the feed.

Milk-of-Lime System

During 1956 a new lime kiln and milk-of-lime system was built at Anaconda, essentially consisting of a $300 \times 8\frac{1}{2}$ ft gas-fired kiln, a 50×7 ft slaker, a 200,000 gal milk-of-lime tank and appropriate materials handling equipment. This plant has a production capacity of 275 tons of burned lime per day as milk of lime.

Milk of lime is drawn from the storage tank by two 4 by 6 in. Vacseal pumps connected to two similar circulating systems in each of the two copper mills. Each system consists of an 1100 ft loop of four in. pipe which traces a path along the feed end of the rod mills and back to the storage tank along the feed end of the ball mills. The lines are installed so there are no gradual rises where "sanding-in" could occur—where they must rise, then are installed vertically. The pipes discharge into the storage tank at the same level as the pump outlet, thus holding a constant pressure in the lines regardless of the level in the storage tank. Fresh water connections and drain lines permit flushing for shut downs. Line pressures equal 28 psi at the rod mill outlets. Slurry flow is regulated 300 gpm and usage ranges between 60 and 100 gpm.

Special Valves Feed Slurry To Mills

There are two takeoffs at each grinding mill consisting of $1\frac{1}{4}$ in. nipples welded to the top of the four

(*continued on page 71*)

PLANS FOR ROOF FALL CAMPAIGN SET

AN advisory committee representing all segments of the coal mining industry has announced the 1960 National Campaign to Prevent Injuries from Roof Falls in Coal Mines. This campaign which is to be conducted by the National Safety Council will begin January 1, 1960, and terminate December 31, 1960.

The campaign goal of 50 percent—or better—reduction in frequency rate of injuries from roof falls presents a challenge to large and small mines alike to reduce this needless waste of life and human-values—not to mention the tremendous economic loss to the industry.

This campaign is sponsored by the following:

1. **American Mining Congress**
2. **Bituminous Coal Operators Association**
3. **Coal Mining Institute of America**
4. **Coal Mining Publications**
5. **Coal Mining Section of the National Safety Council**
6. **Insurance Carriers**
7. **Mine Inspectors Institute of America**
8. **The National Coal Association**
9. **Southern Coal Producers Association**
10. **United Mine Workers of America**
11. **U. S. Bureau of Mines**
12. **State and provincial mining departments, and others interested in coal mining safety.**

All underground coal mines in the United States, Canada or elsewhere are urged to participate in this campaign. Companies operating two or more mines are asked to enroll each separately. Entrants will provide a simple report of injuries resulting from falls of roof, rib and face for one of the three years immediately prior to 1960. Participants will provide a report at the end of the first six months of the campaign, and similar report covering the campaign's final half.

Materials intended to develop and maintain the interest of employer and employee alike have been developed by the advisory committee and the National Safety Council and are available from the National Safety Council at a nominal cost. These materials include:

POSTERS

A special series of 14 two color posters were designed for this campaign. Two 17 by 23-in. posters are available, designed to aid you in announcing the campaign, and illustrating a month to month comparison of injuries in your mine. Twelve 8½ by 11-in. posters, which graphically illustrate special aspects of preventing roof fall injuries, are included. (One for each month of the campaign.)

FACTS ABOUT ROOF FALLS

A series of 12 two-page information filled sheets are available, one for each month of the campaign. They cover such subjects as how to detect loose roofs, the importance of observing standard roof bolting or timbering plans, facts about falls of roof, etc.

ROOF FALL SAFETY TIPS

Illustrated booklets (a series of four) emphasizing safe practices pertaining to the prevention of falls of roof.

REFLECTING SAFETY SIGNS

Four different colored reflecting signs, each 4 by 12 in., on sturdy adhesive-backed stock. These reflecting signs dramatically remind the miners of roof fall dangers, and of precautions to be taken to avoid accidents from this cause. They are to be mounted in different parts of the mine at intervals of three months.

HARD HAT STICKERS

Pressure sensitized stickers with the words *Prevent Roof Falls* have been made available for miners hard hats. These stickers are intended to identify each underground worker as a participant in the campaign, and to help develop safety consciousness by "pride of accomplishment."

Awards will be given by the National Safety Council to mines, supervisors, local unions and safety committeemen who achieve the campaign goal and who meet the other necessary requirements.

A Certificate of Achievement will be given each mine which has a 50 percent or more reduction in frequency rate of injuries from roof falls, and which meets the other campaign requirements.

A Certificate of Commendation will be awarded to each supervisor providing that he goes through the campaign year without any of the personnel under his jurisdiction having a chargeable injury from roof falls, provided he meets the other necessary requirements.

A Certificate of Meritorious Service will be awarded to each local union providing that the mine in which its members are employed are awarded a Certificate of Achievement. The local union must participate actively in the mine campaign program.

A Certificate of Commendation will be awarded to local union safety committeemen providing their local union wins the Certificate of Meritorious Service.

THIN SEAM CONTINUOUS MINING

With the New Full Dimension

Extensible Conveyor System

By VICTOR L. HURLEY
President
Cedar Creek Mining Co.

ALL-conveyor transportation is basic to bringing transportation costs for thin seam mines to a competitive level with thick seam operations in the same market. This article describes an important advance in the conveyor mining art—the first installation of the "new full dimension extensible conveyor system," whereby continuous mining machines can now work entire shifts without interruption for transportation. The all-conveyor operation discussed is that of the Crichton Coal & Coke Co., operating in the Miller B seam in Indiana County, Pa. Coal seam thickness is approximately 38 to 44 in.

A. B. Crichton, Jr., president of Crichton Coal & Coke, is an outstanding advocate of conveyor mining. He was the first user and the outstanding operator identified with the popularization of the bridge conveyor. The Crichton Coal & Coke organization was therefore already familiar with the use of the bridge conveyors and high capacity mobile chain conveyors which make up components of the "full dimension" mining system.

Previous Practice—Includes Highly Successful Room Mining

The company uses Model 76-AM Colmols for mining all of its tonnage. Rooms are driven approximately 35 ft wide (four Colmol lifts) on 50-ft centers. Equipment used behind the continuous mining machine includes loader, Piggyback bridge conveyor and high capacity chain conveyor with crawler mounted head section. Chain conveyor discharges directly onto entry belt conveyor. Lifts are approximately 37 ft deep and pan-ups are made six pans at a time with the assistance of a mobile pan transporter. This machine is crawler mounted with hydraulic lifts and is capable of going to the last previous room and picking up five pans and chains at a time without disassembly. Because each pan-up in this case permits uninterrupted mining of approximately 195 tons, pan-ups do not represent a substantial delay. Moving from room to room represents only the mobile equipment, as the pans and chain are left in place and transferred through the breakthroughs as needed. Other methods of transportation had been used and it is worthy of note that the system using bridge conveyors and chain conveyors has permitted peak tonnages of more than 100 tons better than the best peaks realized with shuttle cars in the same system.

Problem—Achieving Fast Development, High Production

It will be noted that the conventional bridge conveyor and room conveyor setup described above loses some of its advantages in narrow entry work where moves are more difficult and frequent, where pan-ups do

Fig. 1. The author believes conveyor haulage is needed to reduce transportation costs in thin seam mines to a minimum

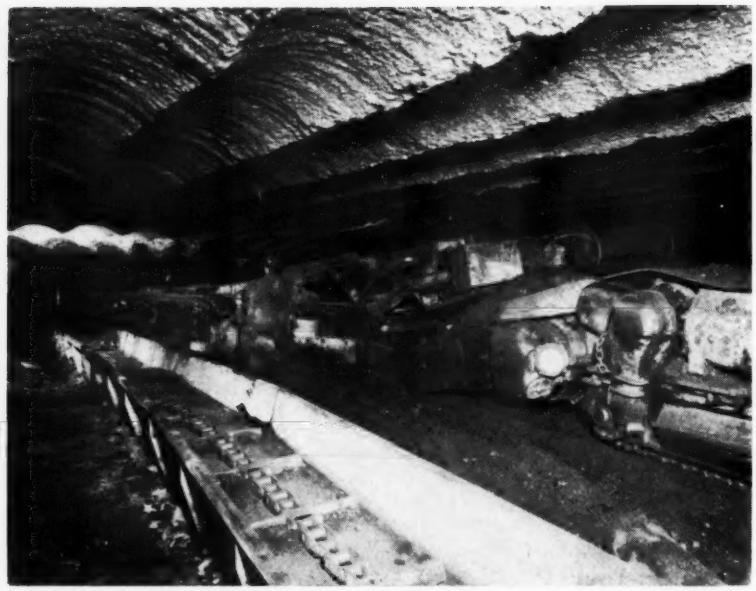


Fig. 2. Equipment behind the continuous mining machine in room work includes a loader, a Piggyback bridge conveyor and a high capacity chain conveyor with crawler-mounted head section

not represent so much tonnage and where wider breakthrough distances present a problem of side reach. For this reason, prior to the introduction of the "full dimension" system, shuttle cars were continued in use for entry driving. Of the two Colmols operating, it was normal to have one operating in rooms and one in entries. The Colmol operating in rooms onto bridge conveyors normally produced at a rate more than 100 tons per shift greater than the Colmol operating with shuttle cars in entries. Achieving faster development and higher production in entries was a necessity for profitable operation.

Answer—An Extensible Conveyor System With Side Reach

In the fall of 1958 an opportunity was given Crichton Coal & Coke to be the first to install the "new full dimension extensible conveyor system." As noted above, this system permits continuous mining machine operation for entire shifts without interruption for transportation. Indeed, the major difference between this system and other extensible systems is the availability of sufficient articulated side reach to permit the working of almost any normal mining pattern. Other extensible conveyor systems have been limited to use in single rooms, on close centers. Such is not the case with the new system. Note from figure No. 5 that it is practical to work a normal five-entry heading on 60-ft centers. The added tonnage without interruption of transportation that results from this extreme side reach is obvi-

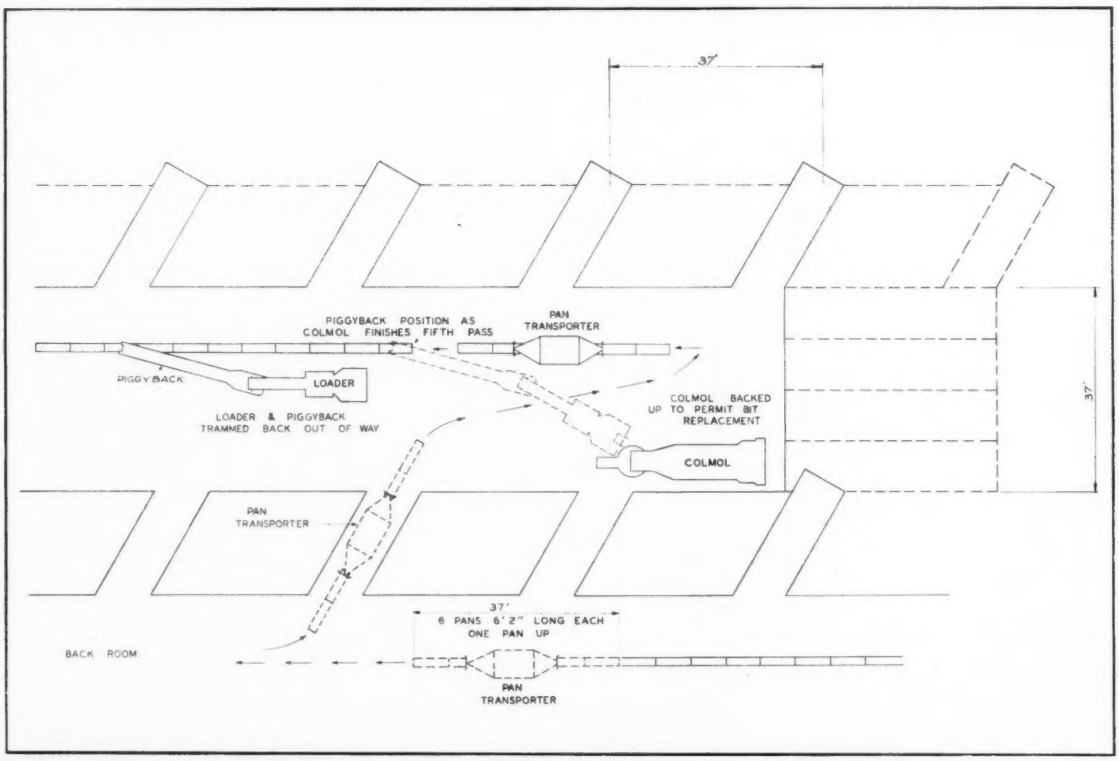


Fig. 3. Lifts are approximately 37-ft deep and pan-ups are made six pans at a time with the assistance of a mobile pan transporter—a crawler-mounted machine with hydraulic lifts. Only the mobile equipment is moved from room to room; the pans and chain are left in place and transferred through the breakthroughs as needed

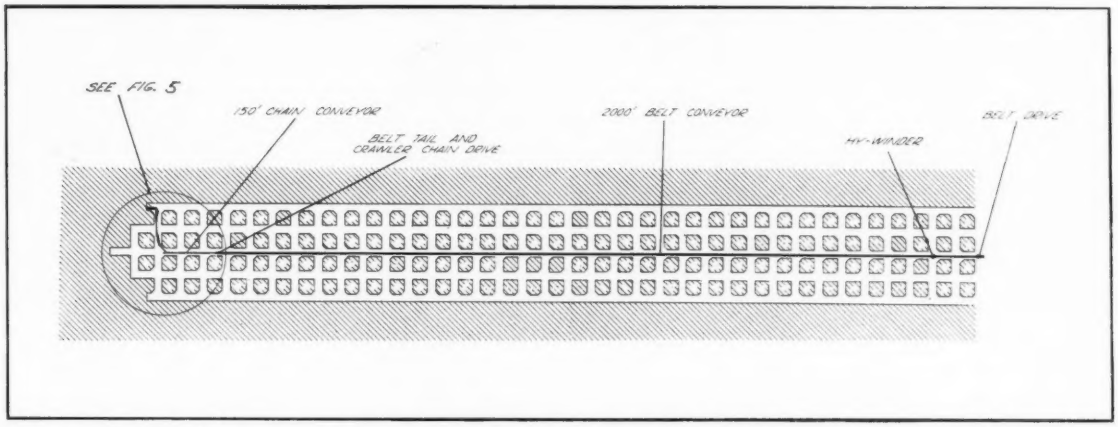


Fig. 4. "New full dimension extensible conveyor system" permits continuous mining machine operation for entire shifts without interruption for transportation. See figure 5 for more details

ous. For each breakthrough extension of the conveyor system, approximately 1300 tons are mined. Bonus advantages are many, but the real big difference with this system is the almost complete elimination of continuous mining machine waiting for transportation.

The principal new item of equipment in this system is the mobile bridge carrier (figure No. 6), which when combined with two Piggyback bridge conveyors forms a three unit bridge conveyor, giving the articulated reach necessary to mine multiple headings. In the case of Crichton Coal & Coke, equipment in use included one 76-AM Colmol, one pick-up loader, a PT-218 Piggyback attached to the pick-up loader and discharging onto the mobile bridge conveyor, a mobile bridge carrier, a second PT-218 Piggyback attached to the mobile bridge carrier and discharging onto the 150 ft long mobile chain conveyor. Note that extensibility results from the ability of the articulated train of equipment to back up alongside the mobile room conveyor and for the second Piggyback to travel the entire 150 ft length of the mobile chain conveyor.

15–30 Minute Belt Move-Ups at Breakthrough Intervals

In figure No. 4 it will be noted that a five-entry projection on 60 ft centers is shown. In 42 in. of coal each breakthrough extension would account for the mining of 1300 tons of coal, with no interruption due to the transportation system. After this 1300 tons is mined it is necessary to get ready to mine another 1300 tons. A simple method is included in the new system for quick extensions of the belt conveyor which also forms a part of the system. The mobile chain conveyor

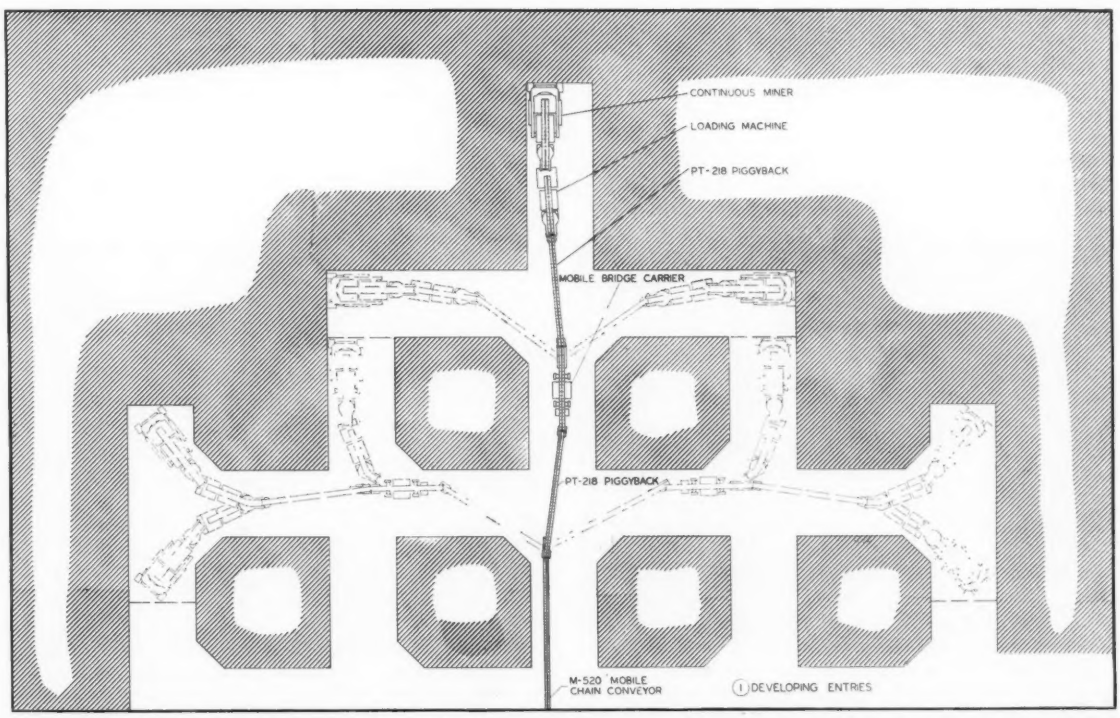


Fig. 5. A major advantage of the system shown above is the availability of sufficient articulated side reach to permit the working of almost any normal mining pattern. Note that it is practical to work a normal five-entry heading on 60-ft centers

Fig. 6. The mobile bridge carrier can make turns on six-ft inside radius and has an unusual type of four-wheel steering which allows it to move sideways. Inset provides another view of machine

incorporates a belt tailpiece. Belting is added and taken off on spools in lengths equal to the breakthrough distance. Spools are handled mechanically in a Hy-Winder belt re-wind device. This device provides hydraulic lift for positioning of spools and hydraulic power for re-winding the belt on the spools. When an extension or retraction is being made, the mobile chain conveyor moves out or in as a unit. The conveyor has a crawler-mounted head and the mobile bridge carrier is used at the opposite end to assist the move.

One of the important advantages of the new system is that it has been demonstrated practical to extend the "full dimension" belt conveyor the full depth in entries as deep as 2500 ft. Belt structure and belting is standard heavy duty construction and is of the same type recommended for permanent and semi-permanent installations. After the "full dimension" conveyor has been extended to its full depth in entry development, it remains in position for room recovery and pillaring. It should be noted therefore that belt move-ups in the usual sense are eliminated with this system and exist only as an on-shift part of the face cycle, every third or fourth shift.

System Achieved With Minimum of New Equipment

Inasmuch as Crichton Coal & Coke already had available many of the components named above, obtaining the benefits of the complete system represented relatively low investment. The company for instance already had Piggyback conveyors and mobile

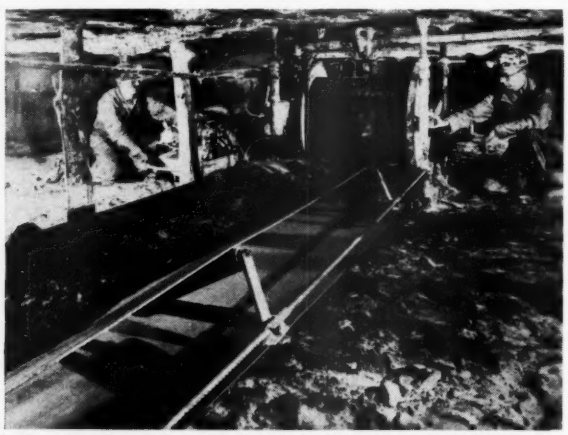


Fig. 7 and 8. A simple method is included in the "full dimension" system for quick extensions of the belt conveyor which also forms a part of the system. The mobile chain conveyor incorporates a belt tailpiece. Belting is added and taken off on spools in lengths equal to the breakthrough distance. Spools are handled mechanically in a belt rewind device. When an extension or retraction is being made, the mobile chain conveyor moves out or in as a unit. The conveyor has a crawler-mounted head and the mobile bridge carrier is used at the opposite end to assist the move

Fig. 9. A wheel-mounted junction box, which is kept in the vicinity of the mobile chain conveyors, includes circuit breakers and plugs for protection and convenience in handling the various face machines

chain conveyors adaptable to this system. The major item of face equipment required was therefore the mobile bridge carrier. A belt drive already on hand was used in conjunction with the "full dimension" belt conveyor.

The electrical controls are particularly interesting in that a wheel-mounted junction box is kept in the vicinity of the mobile chain conveyors. Included in the junction box are circuit breakers and plugs for protection and convenience in handling the various items of face machinery. A large contactor operating in sequence with the belt conveyor shuts off the chain conveyors whenever the belt stops, staying off momentarily and then coming back on to permit items to move for repositioning, even though the belt is down.

Advantages Include Ability to Turn Corners

With the new system it is practical to operate through any breakthroughs normally considered practical for shuttle car mining. In addition to the continuous mining machine itself, the important piece of equipment to get through the breakthroughs is the mobile bridge carrier. This machine is only six ft wide and has an unusual type of four-wheel steering. Not only can the unit make turns on six ft inside radius, but also as a result of individual axle steering, it is possible for the mobile bridge carrier to move parallel sideways. With this unique ability to move sideways, the machine has almost unbelievable maneuverability. If the operator finds himself in a tight spot he does not have to back up for another run—he simply "sets over."

Other advantages concern safety, ventilation, roof support and good housekeeping. For example, it is practical to carry permanent stoppings right up to the last open breakthrough. With this possibility and the elimination of moving transportation equipment, the inherent improvement in face ventilation is readily apparent. Similarly in the case of roof support, only the center entry need be kept open for machinery travel and outby entries may be posted as close as desired without interference to mining. It is true that the intersection normally 100–150 feet back from the face needs to be kept substantially open in the same manner as a shuttle car intersection. Nevertheless, there is not the constant movement of the latter and the intersection is moved forward approximately every two days. The better housekeeping that has resulted has been commented by all.

The crew used at Crichton Coal & Coke with the Colmol and "full dimension" consisted of the following: One Colmol operator, one Colmol helper, one loading machine operator, one mobile bridge operator, one utility man, one mechanic and one foreman. This crew represented one less than the normal crew used previously.

Result—An Increase of 112 Tons Per Shift

Within a relatively short time after the installation of the unit, a month-long performance of 474 tons of material per shift was achieved. This represented an increase of 112 tons per shift over performance with the previous system in entries. This does not by any means represent the potential of the system, because the potential of the transportation system is limited only by the capacity of the mining unit. The conveyor system has a capacity of 300 tph.

In conclusion, the "full dimension extensible conveyor system" has inherently more capacity than shuttle car systems. It is the first extensible conveyor system with sufficient articulated side reach to permit the mining of multiple heading systems and for practical use in pillaring. While it gave Crichton Coal & Coke a fine answer to the entry driving problem, it is also obviously practical in room work as well. This is an important new system with advantages not obtainable heretofore.

AUTOMATION at ANACONDA

(Continued from page 65)

in. line and each followed by 1¼ in. Nordstrom plug valves. These connections are kept closed to prevent sanding in. One takeoff is piped directly to the mill and can be used as an emergency manually operated feeder.

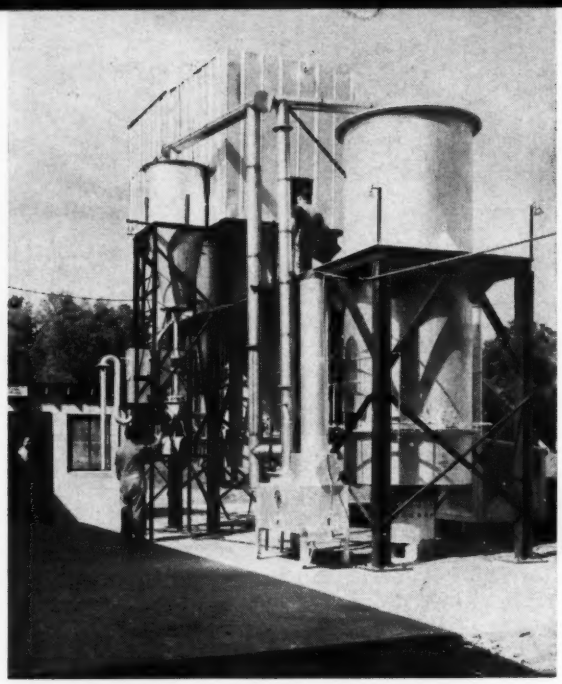
No type of regulating valve tested proved satisfactory for control of milk-of-lime slurry because of severe wear and the difficulty of maintaining a uniform flow, so the second takeoff is connected to a Red Jacket valve which is used as an on and off valve. This valve consists of a barrel-shaped housing and a rubber sleeve insert thru which the slurry flows. When air pressure of five pounds in excess of the slurry pressure is applied between the housing and rubber sleeve, complete closure of the valve is effected.

A Percent-O-Cycle timer actuates two ½ in. solenoid valves that admit and release air for operation of the Red Jacket valves. Timers are made to operate on 15, 30, 60, or 120 sec cycles and have a dial that can be set to range from 2 to 98 percent of these time cycles. An orifice in the slurry line adjusts the flow to approximate lime requirements with the Red Jacket valves open about 50 percent of the time on a 30 sec cycle. These timers can be located remotely from the feeder and near the point of the titration of pH measurement, and they can be quite simply integrated into a control system where continuous pH measurements are possible.

The lime system is very clean and easy to operate and maintain. In two years of operation lime scaling has not occurred in any of the lines or valves, which is probably due to elimination of air from the entire system.

Automatic control of many industrial operations is surely desirable from an efficiency and productivity standpoint, as well as resulting in decided improvement in working conditions in a large number of applications. No supervisor will contest the increasing importance automation is playing in modern industry.

Engineering and design are only one phase of the problem, however. Man is inherently resistant to change and ready acceptance of automatic control systems is often difficult to obtain. Management not only has to provide these extremely useful tools, but must point out the advantages to all concerned with a good educational campaign in order to attain maximum benefit from automatic equipment.



The fluidized bed has come into prominence in recent years as a process for extracting useful values from minerals. Pictured is a research unit suitable for ore roasting on a tonnage basis

What RESEARCH can do for the MINING INDUSTRY

By DAVID C. MINTON, Jr.
Vice President
Battelle Memorial Institute

Areas where research offers possible solutions to economic problems:

- **cost reduction**
- **by-product utilization**
- **diversificaton and integration**
- **development of new uses for mineral products**

AT the time of the 1953 American Mining Convention in Seattle, the mining industry was plagued with many of the same problems facing it today: foreign competition, inadequate and unstable prices, competition between metals, overproduction, overcapacity, rising labor costs, strikes, stockpile uncertainties.

At that time, although the business picture looked bleak for some segments of the U.S. metals and minerals industry, the difficulties were not as significant as the long-range favorable prospects. Consumption trends for almost all of the metals were definitely upward, and constantly increasing population, constantly increasing standards of living, and research and technology assured the continuance of these trends.

Many things have happened in the past six years. The economy has had its ups and downs—two recessions, two booms (if the present situation can be called a boom)—and the mining and metals industries have shared variably in these events, and in other ups and downs of their very own. But when we look at the long-term growth trends of U.S. metal consumption, we find that they are still pointing inexorably upwards. The performances of most metals since 1953 are practically continuations of the long-term performances established before that date.

Most businessmen understand today that the U.S. economy—the world economy, in fact—is expanding and has an effect of eventually smoothing out problems that seem so forbidding today. And most people understand that research produces or accelerates this expansion. Outstanding developments since World War II, such as high-speed aircraft, nuclear power plants, missiles, computers, electronic controls, and the like, are examples of the results of research. These have made markets for the products of our mining industry, and some, in fact, have created markets for a number of metals that were once but elements studied lightly in chemistry courses. Uranium, zirconium, titanium, molybdenum yttrium, columbium, boron, germanium, tellurium, and selenium have all been the demand babies of these modern developments and the research that created them. However, the question of the moment is: What can research do to help mining and metals companies solve their current difficulties? Can research be of any real aid at all?

Certainly, the answer is yes—there

is plenty of room for economic improvements in mining, concentrating, smelting, and fabrication operations through the application of research and technology. The effected economies may be trifling compared to benefits that might be obtained through tariff or import quota actions, but they might make the difference between a modestly successful operation and a failing one during periods of adversity. To be realistic, the mining industries might well face up to the probability of continuing troublesome times, interrupted sporadically with spells of prosperity. They should be psychologically attuned to the nature of their businesses when they consider trouble their norm and prepare for it accordingly. Then during good times, their return will be even greater. Research is a tool that should be constantly employed to shade costs and to upgrade the monetary value of the products—even as attempts are made to bring about the political reforms that could ameliorate difficulties.

The problems of tariffs, quotas, stockpiles, tax reforms, etc., are outside the scope of this article. But note that it is dangerous to put all your eggs in one basket—to look to political action for the ultimate solution of minerals problems. Possibly in time, political action will be a losing fight—free trade—or at least freer trade—is the goal toward which all the world economies are moving by evolutionary processes. Furthermore, when and if free trade comes about, perhaps it will not be such a bugaboo as it appears at present, for concurrently there will certainly be an equalization of the labor cost factor through the rise in standards of living of foreign peoples. Competitive advantages then would depend on who is located most advantageously, who has the best grade of ore, who has the most favorable tax structure, and who has the superior technology.

However, it would be foolish to wait for time to take care of existing problems through evolutionary changes. Industry has responsibilities now and everything must be done to preserve it and make it profitable.

At present, the domestic mining industry has two major advantages over foreign competition—proximity to the world's greatest market, namely U. S. industry—and a superior technology. This country does not have, in many cases, the best grades of ore—although who can say what blind ore bodies may be awaiting detection by some new means of geophysical exploration yet undreamed of? But whether or not such bodies exist, through research American industry can whet to a keen edge the proven advantages of market proximity and superior technology. Thereby is the opportunity to achieve at least small increments in earnings, that will help sustain business during slumps and buoy profits when times are good. This means research at all phases of operations—from exploring for mineral deposits to the marketing of products. Remember, research is not a panacea; but there are opportunities to whittle down economic difficulties by putting research and technology to work.

Integrated processes to recover multiple values are required to make some mining operations economically feasible. Pictured is a scale model of a pilot plant for the technical and economic evaluation of a process to recover copper, lead, and zinc from a complex sulfide ore

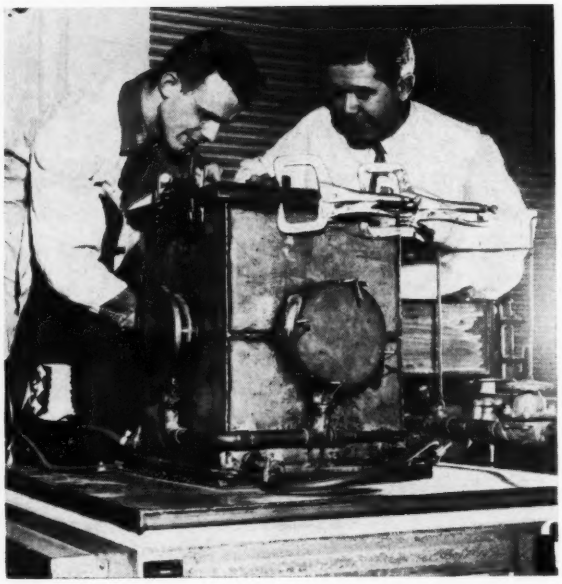
But, where are those opportunities? This is the big question. This is a question asked of several experienced minerals research people and, surprisingly, it elicited not a dearth, but a plethora of ideas. Some of the ideas sounded realistic and practical; others were highly imaginative—blue-sky; others bizarre, but they could be categorized under four basic concepts.

The four avenues to the betterment of mineral economics through technical, economic, and market research are: (1) *Cost Reduction*, (2) *By-Product Utilization*, (3) *Diversification and Integration and* (4) *New Uses. Each* of these avenues will be considered individually, although they are linked so inseparably that boundaries, between one concept and another, are often mere fictions.

Cost Reduction

Cost reduction through modernization in production is an area of research in which most mining companies have been active for many years. The very fact that U.S. labor costs, per ton of crude ore mined even in face of higher hourly wages for workers, are lower than in many other countries is testimony to the success of such research and the superiority of U.S. technology.

The best prospects for direct cost reduction in mining and smelting operations would seem to be in further mechanization, and here the producing companies might fare better by shouldering their own unique developmental tasks rather than depending on suppliers. The old idea that the development of equipment is the supplier's problem has been a drag around the industry's neck. The supplier, grateful as he is for new business, doesn't want to research an idea unless he thinks it will sell to a wide market. In recent years mechanization has brought about many examples of sharp cost reductions, for example; American Zinc, Lead and Smelting Co. reduced its manpower requirement at one mine by 52 percent through the development of a mining and mucking machine. Also, the company increased its output 33 percent per man shift, by the mechanization of its Dumas, Texas, smelter. Other mines and smelters have shown similar gains, and the companies that have spent most on mechanization



A constantly expanding technology tends to open new opportunities for the mining and metals industry. Shown is laboratory equipment for the electrorefining of refractory metals, such as titanium, vanadium, and zirconium, through electrolysis using fused salt

and the development of equipment to fit their special operations seem to be the ones looking hopefully toward further improvements.

A number of progressive mining companies are finding that efficiencies can be improved and cost reductions achieved by the proper utilization of operations research, involving the application of sophisticated mathematical techniques in the solution of a variety of operating problems. International Minerals and Chemicals Co. has achieved much success in applying these techniques to its phosphate dragline operations in Florida.

Mining operations are characterized by the handling of much weight. Anything that would cut down weight handling would be a step toward cost reduction. Underground milling and even underground smelting have been suggested as ways to keep from transporting vast quantities of waste material to the surface. How far one can go in this direction remains to be explored; certainly, the salt mines below the city of Detroit are suggestive of what can be done in special circumstances.

Besides trying to minimize the moving of ore, there are other ways to achieve some economies in weight handling. Development of the removable bit, improved in turn by the carbide insert, is an example of how a technical development can cut weight handling. Mines no longer have to hoist and lower tons of drill steel up and down shafts every day. Perhaps economies in weight handling might be achieved by going to such things as light-metal skips, cages, and so forth, or by developing new concepts of water lifting. Every tiny fraction of savings in energy costs will be a fraction added to the right side of the ledger.

Sometimes improvements in mechanical equipment negate the economics of minimizing weight handling—as in the case of open-pit mining with gigantic earth movers. Today over half our mineral output is obtained this way, and open pit stripping is carried on at depths up to and over 600 ft. Obviously, in strip mining the minimization of weight handling is not a feasible approach to cost reduction. Here, and in the case of underground mining, industry must look to modernization in subsequent processing, and to finding values from the waste materials to help pay handling costs.

By-Product Utilization

By-product utilization has, of course, been the subject of intensive study in recent decades, and where the economics have proved practical companies are getting subsidiary values—in the form of such diverse materials as gold, silver, sulfur, potash, molybdenum, iron, indium, rhenium, germanium, and selenium —from their ores and concentrates. Current economics usually dictate whether or not a by-product is recoverable, but, too often, companies who investigate by-product recovery tend to regard the existing economics as immutable. Many technical, sociological, and political developments are acting to change the economics constantly, and what is impractical today may be a bonanza tomorrow. A technical development in aircraft or missiles or nuclear power can make a trace metal constituent a valuable by-product. A raise in railway freight rates may make say, by-product alumina, a favorable feed for a nearby aluminum reduction plant. The building of a network of highways near the mine may open demand for locally derived concrete aggregate. Any whim or whimsy of the American people may create a market for something that has previously been thrown away. Take the current outdoor barbecuing craze, for instance; it has made hardwood forest wastes the raw material for a profitable specialty item in the form of charcoal and charcoal briquettes.

Any mining company, big or small, should be constantly on the lookout for opportunities that might enable it to derive new values from its products, wastes, operational residues, tailings, or effluents. A critical analysis of all of these might disclose materials of interest. Then a careful study of the entire flow sheet from mine to final product might uncover possibilities for winning these materials economically. These are indeed challenges to research. They are opportunities—but opportunities not easy to find.

Some 25 years ago an official of one of our major copper producers stated that it was crazy to analyze his mine and mill composites for molybdenum. He said that the ore contained but a trace. Several years later molybdenite was one of his company's profitable products, but he was led by the examples of Greene-Cananea and Utah Copper, rather than by his own studies. It would be well worth the investment for a mining company to have at least the rudiments of the technology needed to capitalize on promising by-product situations—ready to spring that technology when the occasion warrants. It should not look upon opportunities for by-product operations as ventures that must justify the research and capital expenditures on a customary net-return basis, but as ventures that will help defray the costs of the major mining or processing operation. Stockholders don't care if the profit is made from the main material being produced, or from material plus a hodge-podge of auxiliary products and operations.

The important point in regard to by-products is that they often give

an advantage that foreign competitors cannot hope to meet. If a superhighway is to be built through a state where the XYZ Mining Co. operates in producing a nonferrous metal from a low grade ore, and if XYZ Mining Co. has waste rock on hand that would make ideal road ballast and concrete aggregate, there's not a way in the world that the competitor in Africa or South America can get this rock business. If XYZ's profits as the result of this by-product business are adequate, in spite of the low price for the nonferrous metal, foreign competition has lost its sting.

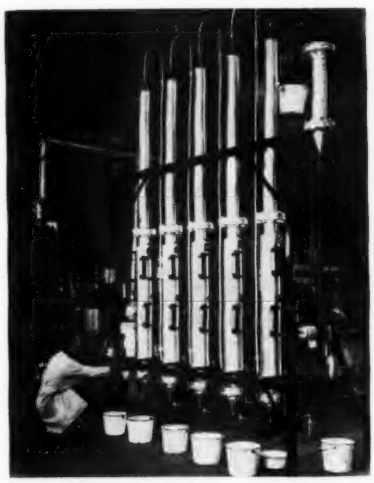
Diversification and Integration

This hypothetical example may be carried a bit further to illustrate the next concept—namely, diversification and integration. Suppose after XYZ Mining Co. gets into the aggregate business — after it is supplying crushed stone in various sizes—it notes that towns are building up along the highway right-of-way, that businesses and industries are moving in, that considerable construction is going on. XYZ may decide that it can increase the return from its aggregate business by marketing some of the aggregate in the form of concrete building blocks, or other concrete products, building stone, or cement. It takes the step, diversifies into the building materials business, with a series of products *that have more labor tied up in making them.*

Parenthetically, it is interesting to note that less than three percent of the workers in the nonferrous metals industry are in mining, about 13 percent are in primary metal production, and about 84 percent are in fabricated or ultimate products. And in the same connection—on the advantages of having more labor in a product—note that the American Machinist Magazine's index of metalworking production reached a peacetime high in July, breaking the previous record set during December, 1956. Can anything like this be said for the mining industry?

But, getting back to the main point, what are the advantages of having more labor in a product? They are obvious. There is a management-plant-know-how mark-up on the labor constituent as well as on the materials constituent, so the total "take" from a ton of what was rock in the ground is much more. An important point to remember is that no raw material has hardly more than aesthetic value before labor is put into it. A vein of zinc ore buried in the ground is useless. But once labor has turned that ore into zinc metal, possibly with copper, germanium, and selenium as by products, the material has value. It becomes *quite* valuable as the zinc is fashioned into a die-casting, the copper into a plumbing fitting, the selenium into a rectifier, and the germanium into an electronic detector or diode.

Of course, there are reasonable stopping points in this upgrading procedure for any company, but the point is that creating an economically upgraded product is the way to get the most from diversification or by-product utilization. Note how many of the diversification movements in industries other than mining are going in the direction of economic upgrading—puting more work into the products sold. Note how fabulously successful the aluminum producers in this country have been, because they put labor into the primary metal and upgraded it economically into more profitable products. Are they worried because their costs in making aluminum ingot are greater than those of their foreign competitors? It would be incorrect to say "no", but some are surely worried more than others. It is interesting that the lowest cost ingot producer on this continent is the only aluminum company having profit difficulties at the moment. This company is now turning to aluminum fabrication through subsidiaries in order to solve the problem of how to make money with a primary metal.



Laboratory equipment for the extraction and recovery of uranium by the ammonium carbonate pressure-leach process

As a whole, few, if any, basic materials today are adequately profitable. The independent farmer could hardly exist without his government price supports and subsidies. But the corporation that puts additional labor into agricultural products, and transforms them into packaged frozen foods, prepared food mixes, and canned and bottled goods, makes substantial earnings from its upgrading efforts. The same applies to forest products, to nonmetallic minerals, to petroleum, to virtually any raw material you can name. Steel, the most basic material of our technological economy, illustrates well the advantages in a diversified product mix. Steel isn't content to sell ingots or slabs, or even bars, sheet, or rods. It sells a complex of semi- and finished manufactures—increasing the "take" from the raw material manyfold. Recently, in a research laboratory of a major steel producer, the author saw a complete new line of steel window sashes and screens, curtain wall units, and other items that are now ready for introduction. The same story applies to petroleum. Profits in just marketing the crude are generally increased substantially once the crude petroleum has been processed into gasoline, fuel oil, lubricants, waxes, and a host of petrochemicals.

The key point is that, as a result of oversupply, overproduction, overcapacity, and foreign competition, no producer of a basic raw material has much of a chance for satisfactorily profitable operations from the selling of his primary material alone these days. He must diversify, either by offering the material in varied, upgraded forms; by going into the production of intermediates, semimanufactures, or finished consumer products; by exploiting a line of by-products; or by going into exotic business ventures. And to find the diversification opportunities, technical, economic, and market research are needed.

In order to get the last bit of squeal from the pig, mining companies might take a few lessons from other American firms that have gone to the extreme in diversification. Where the opportunities exist, would it be out of order for mining companies to operate such things as hotels, tourist attractions, ski lifts, cattle ranches, lumber mills, water supply systems, etc.? Pan-American Airways is in the air transport business, yet it operates hotels, and has also engaged in contract research and development—because there are opportunities here that tie in with its

(*continued on page 80*)

The Electrical Side of

Coal Preparation Plant Design

By D. E. HAMILTON
Application Engineer
Industrial Engineering Section
General Electric Co.

THE increased cleaning required to provide coal which will meet present day market requirements has greatly expanded the use of processing equipment in coal preparation plants. This places increased emphasis on the selection of electric equipment to obtain the utmost in safety, reliability and performance. The various phases of the electric system should be considered early in the planning stages in order that the location of the mechanical and electric equipment may be properly co-ordinated.

In viewing the electric equipment the following points should be carefully considered:

1. Total power requirements
2. Power distribution equipment
3. Motors
4. Control equipment
5. Selection of cable

The following discussion is intended to point out many of the present day concepts which should be given due consideration.

Power Requirements

There is no fixed ratio of connected horsepower to tons of coal cleaned per hour because the power depends upon the process used and whether or not there is a large quantity of fine coal to be cleaned. However, in the early stages before the complete plant is well defined it is desirable to have some yardstick of approximate power requirements. A check of quite a number of plants already built indicates that where there is little or no fine coal cleaning that between two and three connected hp per tph (tons per hour) has been required. When considerable fine coal cleaning is involved the figures may well be as high as four to five hp per tph. If a plant designed for 750 tph, is considered, the connected horsepower requirement may then fall somewhere between 1500 and 3750.

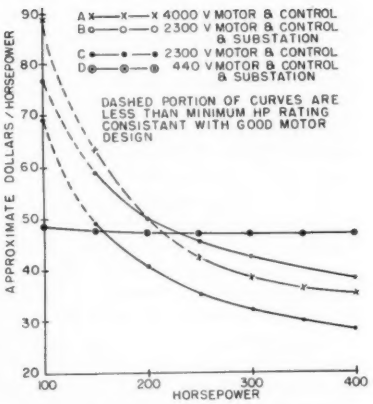


Fig. 1. Approximate costs of motors, control and substations as a function of motor horsepower

Because the power system is designed upon the basis of kva requirements, the horsepower must be converted to kva required. For the normal spread of horsepower ratings encountered in preparation plants a figure of one kva per hp is considered satisfactory.

Also, because the actual selected horsepower rating in most cases exceeds the calculated horsepower requirements due to the range of standard motor horsepowers and because all motors are not always fully loaded at the same time, a diversity factor is used in arriving at the estimated power requirements. A diversity factor of 75 percent is frequently used by various plant builders.

SUMMARY

When considering a new coal preparation plant, the following suggestions bear careful consideration:

1. Determine substation size, taking into account the short circuit protective levels available in the control.

2. Select motor voltages on the basis of the economics of the power distribution system and obtaining best life of motors.

3. Select control having proper interupting capacity and properly sequenced for best over-all plant efficiency.

4. Use solidly grounded low voltage distribution to obtain maximum reliability of the power system.

5. Apply capacitors to improve power factor and reduce required substation size where the economics will justify their use.

6. Select cables to withstand the particular short circuit level as well as for proper ampere and voltage levels.

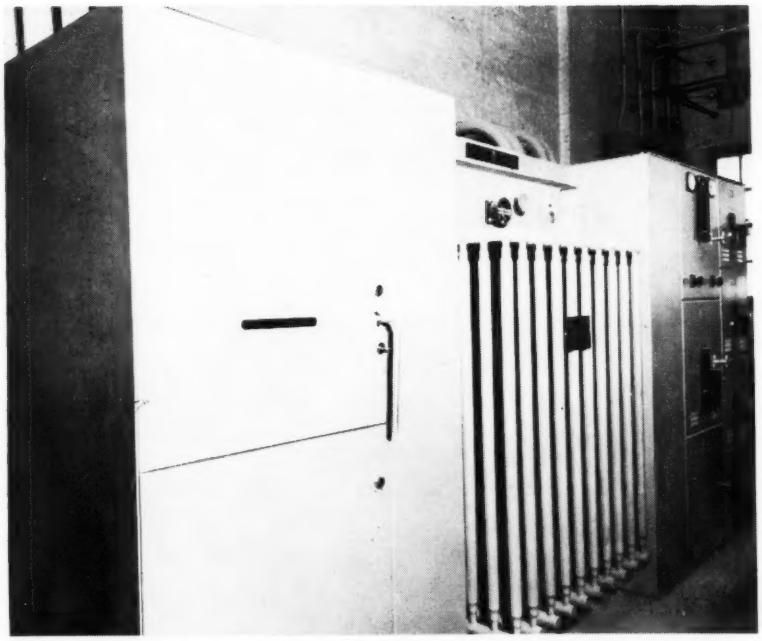


Fig. 2. The load-center unit substation is gaining wide acceptance as the best means of distributing the power

Power Distribution Equipment

Motor Voltages. Having arrived at the total kva requirements for the plant, the next consideration is how the power will be distributed to the various drives. In order to arrive at the best and most economical system, the horsepower range and the available incoming high voltage supply should first be determined.

Knowing the horsepower sizes and available voltage, figure 1 can be used to determine whether the larger motors and control would be more economical at 440 volts or at high voltage. The comparison shown on figure 1 is based upon the use of the following:

a. Open, 40° C, 1800 rpm squirrel cage motors
b. Group control, type C, 440-volt starters
c. Current limiting fused starters for 2300 and 4000-volt starters.

Variations from any of the above conditions would tend to vary the price level but by replotting all the curves on the same basis the same approximate crossover points would result. This would then establish the following approximate economic limits:

1. If 2300-volt power is available without use of stepdown transformers—use 440 volts for motors up to 150 hp and 2300-volt motors for 200 hp and above.
2. If 4160-volt power is available without use of stepdown transformers—use 440 volts for motors up to 250 hp and 4000-volt motors for 300 hp and above.
3. If incoming lines are above 4160 volts—use 440-volt motors up to 250 hp and 2300-volt motors for 300 hp and above.

Use of high voltage motors below 150 hp is not only uneconomical from the first cost standpoint but also uneconomical from an electrical design standpoint.

Substations. Because the majority of the drives encountered in a coal preparation plant fall below the 150-hp range, it follows that there is usually a large amount of 440-volt power required. Before deciding upon the size of stepdown transformer to be used, it is well to consider the short circuit interrupting capacity (IC) available in standard low voltage control equipment. Many mining properties may have considerably less primary short circuit duty than 250,000 kva. However, from the long range viewpoint it is not wise to take too much advantage of this because the power company system may change a few years later and what was once an adequately protected low voltage system may become inadequate.

Use of transformer banks larger than 1500 kva will usually require the use of current limiting reactors ahead of each group control and the over-all economics in the majority of cases has been shown to be in favor of using a number of smaller transformer banks, each feeding only a portion of the load.

Because the motor load is spread over a wide area, often involving several buildings, the load center unit substation as shown in figure 2 is gaining wide acceptance as the best means of distributing the power. There are several factors which determine the most economical size of load center unit. These are:

1. Primary feeder length
2. Secondary feeder length
3. Substation size

Low Voltage Grounding. In the past several years there has been considerable acitvity in the direction of using load centers with wye connected secondaries and to ground the neutral of the 480-volt system, as contrasted to the old practice of using delta connected secondaries and leaving the system ungrounded.

The grounded neutral system is the safest of the two because there is only 277 volts to ground at any time. With the neutral grounded, as soon as any one of the phase conductors becomes grounded there is sufficient current flow to trip the circuit breaker or fuse protecting the circuit on which the ground occurs. This greatly simplifies the job of locating the ground

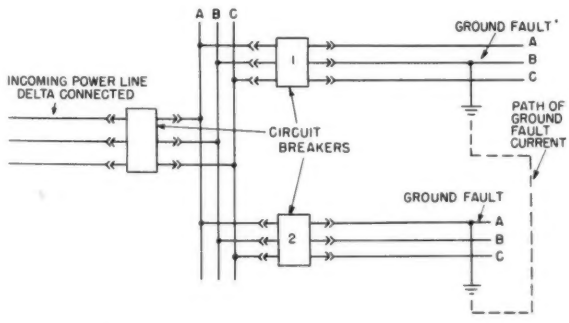


Fig. 3. Possible multiple ground fault condition with ungrounded power systems

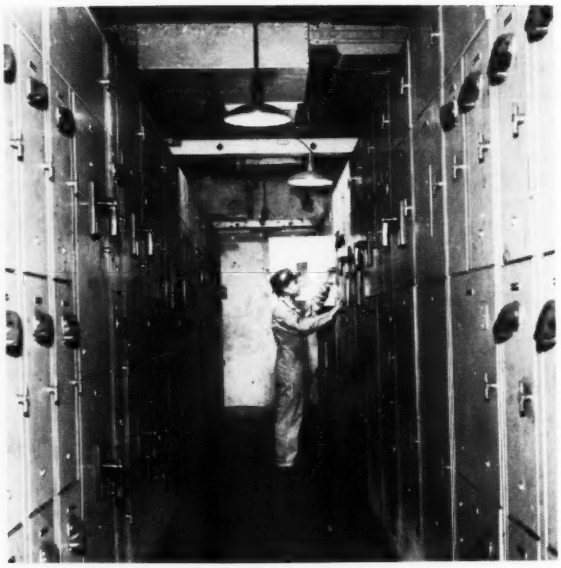
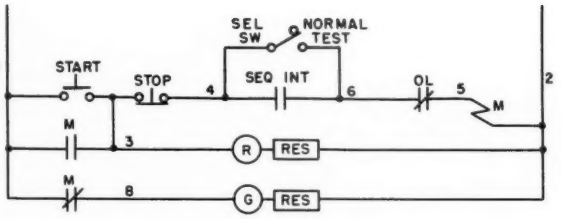
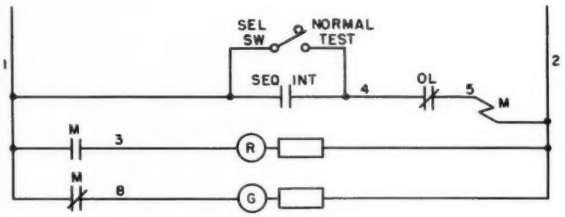


Fig. 4. The large majority of present day plants utilize standard grouped control starter assemblies which are completely wired and mounted in enclosed, dead front enclosures. Such assemblies are then mounted in a readily accessible area where inspection and maintenance can be easily accomplished



(A) PERMISSIVE STARTING CIRCUIT



(B) AUTOMATIC STARTING CIRCUIT

Fig. 5. Typical sequence control circuits

fault because the breaker immediately ahead of the fault will be tripped. If the fault occurs beyond the load terminals of the motor starter, as is frequently the case, operation of the rest of the system may continue while the fault is being repaired.

Another advantage is that only one motor or feeder is involved in the fault. On ungrounded systems shown in figure 3, phase B may become grounded in one motor and the operator would not know it existed unless a ground detector were connected to the system, in which case the ground would usually be left on the system until the end of the shift. At some time later, phase A may go to ground in another motor in the area. In this case two motors will be involved in the fault and considerable time may be lost in clearing up the trouble and repair of the two motors. The usual first reaction to using the grounded neutral 480-volt system is that there will be too much production time lost due to the fact that as soon as a ground occurs the protective equipment shuts the unit down. However, actual experience of many operators indicates that there are fewer shutdowns with the grounded system than with the ungrounded system.

In addition, the voltage stress to ground on the cables is limited to 277 volts and should, therefore, mean that longer cable life should be obtained and fewer ground faults should arise.

Capacitors for PF Correction. An important consideration in the modern preparation plant is that of over-all plant power factor. The majority of the plant load is induction type motors which operate at a lagging power factor. Most power companies have a penalty clause for poor power factor but there is no fixed pattern of the various clauses. Some power companies charge a penalty for anything below unity while others may charge extra for power factor below 80 or 85 percent and have a bonus for better power factor. In either case the cost of improving power factor by means of capacitors can be repaid in a relatively short time by the saving on the power bill.

Motors

After the horsepower and voltage ratings have been determined, the motor type and enclosure must be selected. On drives such as blowers, pumps, air-compressors, valves and small conveyors, normal starting torque motors may be used. On medium size conveyors, screens, crushers and breakers, high starting torque motors are frequently used. On the large conveyor drives, such as ROM conveyors, wound rotor motors are applied in order that belt stresses may be kept within predetermined limits. Centrifugal type filters very often have a very high inertia and in such cases a careful check should be made to see whether wound rotor motors or specially designed squirrel cage motors are required.

When selecting the motor enclosure the location of the motor in the plant should be considered. In the dusty portions of the plant totally enclosed motors are most suitable. In the wet cleaning sections, either dripproof or splashproof motors may be suitable.

Control Equipment

The control starters considered for coal preparation should be of the types having short circuit interrupting capacity. Starters are available either separately mounted or as group controls.

The large majority of present day plants utilize standard grouped control starter assemblies which are completely wired and mounted in enclosed, dead front enclosures. Such assemblies as shown in figure 4 are then mounted in a readily accessible area where inspection and maintenance can be easily accomplished.

One of the important considerations in the control equipment is proper sequence interlocking to prevent costly coal pile ups in the modern large tonnage plants. The plant operation, in conjunction with proper sequencing, can be arranged for either permissive starting or for automatic starting or a combination of both if desired.

In permissive starting, figure 5A, the control circuit is arranged so that each starter is energized by means of a push button, or other initiating device, but not before the starter preceding it in sequence has been energized, unless the circuit is set up for a test operation of a unit.

The automatic starting circuit, figure 5B, is arranged so that only the first unit is started by push button and then successive units start in sequence as a function of the preceding starter being energized. In this type of circuit it is usually advisable to insert time delay relays at various intervals in the sequence to allow units to come up to speed before the units which feed them are started. Without the addition of the time delay relays, units would pick up in order limited only by the inherent time delay pick up of each successive starter.

In plants that use permissive starting circuits there are usually one or more master push button control panels. These may be either of the desk type or of the vertical face type. The desk type, as shown in figure 6, is suitable for use in locations where it is necessary to view the operation of units in all directions around the push button panel.

A typical application for this type of panel is in the boom operators station.

The vertical face type push button panel, such as shown in figure 7, is usually used where a large number of push button stations are involved and over-all visibility is not absolutely essential. Due to its simple construction it is less expensive and the greater mounting area per foot of length results in less floor space required.

Cable Selection

In the over-all electrical design of the plant, due consideration should be given to the selection of the cable.

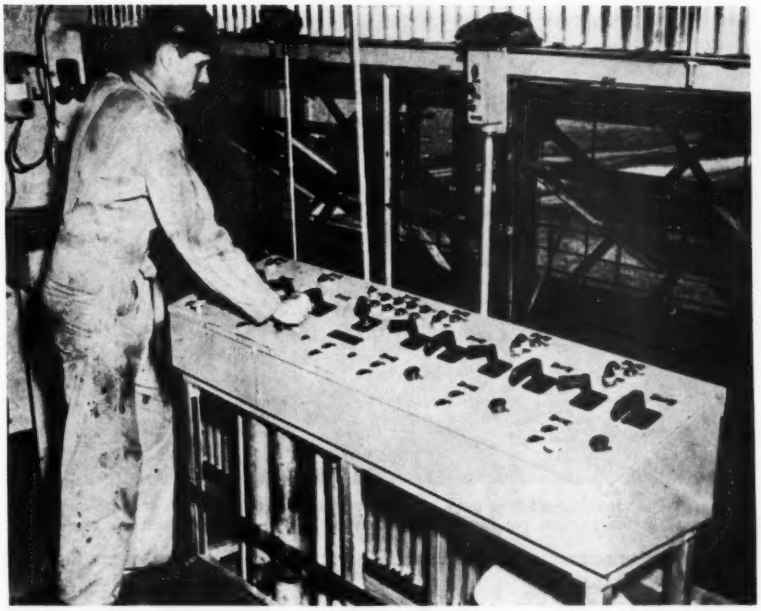


Fig. 6. Desk type operator's control station is suitable for use in locations where it is necessary to view the operations of units in all directions around the push button panel

Table 1. Quick estimating table of minimum conductor size*

A. Low-voltage Air-circuit-breaker Protection

Short-circuit current, amp (1.25 × symmetrical)	Duration of short-circuit current		
	1.5 to 2 cycles (Inst. trip)	¼ sec	½ sec
5,000	No. 8 Awg	No. 4 Awg	No. 2 Awg
10,000	No. 4 Awg	No. 1 Awg	No. 1/0 Awg
15,000	No. 2 Awg	No. 2/0 Awg	No. 3/0 Awg
25,000	No. 1 Awg	No. 4/0 Awg	300 MCM
35,000	No. 1/0 Awg	300 MCM	400 MCM
50,000	No. 3/0 Awg	400 MCM	600 MCM
75,000	300 MCM	600 MCM	800 MCM
100,000	350 MCM	800 MCM	1000 MCM

B. High-voltage Power-circuit-breaker Protection

Short-circuit current, amp 1.0 × symmetrical)	Interrupting kva at				Duration of short-circuit current		
	2.4 kv	4.16 kv	6.9 kv	13.8 kv	8.5 cycles (Inst. trip)	½ sec	1 sec
3,000–3,500	.....	25 mva	.....	75 mva	No. 6 Awg	No. 2 Awg	No. 2 Awg
3,500–4,000	.....	.....	.....	.....	No. 4 Awg	No. 2 Awg	No. 1 Awg
4,000–4,500	.....	.....	50 mva	.....	No. 4 Awg	No. 2 Awg	No. 1 Awg
4,500–5,000	.....	.....	.....	.....	No. 4 Awg	No. 2 Awg	No. 1/0 Awg
5,000–6,000	.....	.....	.....	.....	No. 2 Awg	No. 1 Awg	No. 2/0 Awg
6,000–7,000	25 mva	50 mva	.....	150 mva	No. 2 Awg	No. 1 Awg	No. 2/0 Awg
7,000–8,000	.....	.....	.....	.....	No. 2 Awg	No. 1/0 Awg	No. 3/0 Awg
8,000–9,000	.....	.....	100 mva	.....	No. 1 Awg	No. 2/0 Awg	No. 3/0 Awg
9,000–10,000	.....	.....	.....	.....	No. 1 Awg	No. 2/0 Awg	No. 4/0 Awg
10,000–12,500	50 mva	.....	.....	250 mva	No. 1/0 Awg	No. 3/0 Awg	250 MCM
12,500–15,000	.....	100 mva	150 mva	.....	No. 2/0 Awg	No. 4/0 Awg	300 MCM
15,000–20,000	.....	.....	.....	.....	No. 3/0 Awg	300 MCM	400 MCM
20,000–25,000	100 mva	150 mva	250 mva	500 mva	No. 4/0 Awg	350 MCM	500 MCM
25,000–30,000	.....	.....	.....	.....	250 MCM	400 MCM	600 MCM
30,000–35,000	.....	250 mva	.....	750 mva	300 MCM	500 MCM	750 MCM
35,000–40,000	150 mva	.....	500 mva	.....	350 MCM	600 MCM	750 MCM

* Based on copper conductor, 75 C conductor temperature rise (75 to 150 C), a single interval of short-circuit current conduction, constant current after 1/10 sec.

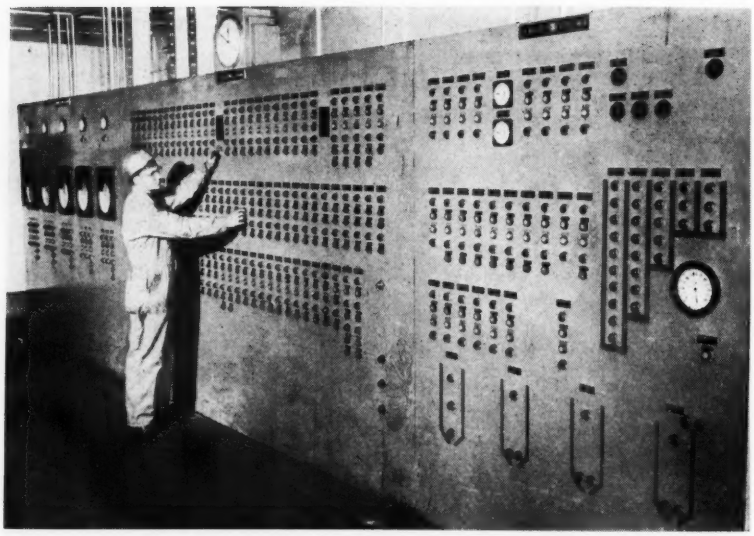


Fig. 7. The vertical, face-type push button panel is usually used where a large number of push button stations are involved and over-all visibility is not absolutely essential

In selecting cable there is considerable information available to choose cable which has sufficient insulation for the system voltage and proper copper cross section to handle the load current with a reasonable voltage drop to the particular load. However, there is another important consideration; that is the short circuit current which the cable must handle and the length of time that the short circuit current will flow before the protective device trips.

Thus the power system short-circuit current magnitude, cable size, and circuit breaker or fuse interrupting time should be coordinated to avoid severe permanent damage to cable insulation during a fault condition. For quick estimating purposes, table 1 gives minimum safe conductor sizes subject to the application conditions shown.

RESEARCH and MINING INDUSTRY

(*Continued from page 75*)

main function and with its skills. Going to and extreme, one coal mining company undertook the manufacture of men's underwear, but through these moves Philadelphia and Reading changed its balance sheet from deep red in 1955 to healthy black in 1958. A textile firm got out of the doldrums by diversifying into such things as the manufacture of chain saws and bathroom fixtures. A big shipping company, which diversified into chemicals, also operates banking and outdoor advertising businesses. Sometimes a company's skills, knowledge, natural environment, location, financial relations, and management background give it strange and unusual diversification opportunities. What is wrong with taking advantage of these? Companies frequently invest their finannancial reserves in the stocks and bonds of other industries far removed from their own businesses. What's wrong with investing such reserves in special opportunities that arise from the company's unique circumstances?

This may sound like a far stretch from the subject, but lots of research in technical-economics is needed in charting good diversification courses into fields so widely removed from metals and minerals production.

New Uses

A great deal does not need to be said about finding new uses for mineral products. The mining industry has a number of excellent organizations, such as the Lead Industries Association, American Zinc Institute, the Rare Earths Research Group, the American Quicksilver Institute, and others, attacking this phase of the problem. "Use" research must be supported vigorously to counter-balance the inroads made by competitive materials. Many mining companies have suffered from the results of the good use-research of others, particularly that of the light metals and plastics industries. Certainly, the old-line nonferrous industries have much to learn from these competitors—and from the glass industry. Many of the industries who have had trouble in their growth patterns have been lacking in imagination—even when they sought new uses for their products. Who would have thought 50 years ago that fly rods and draperies would someday be made of glass? Or that bearings would be made of organic chemicals? Or evening gowns of aluminum? It takes real imagination and persistent research to bring about such transformations. It is hard to believe that the uses of copper, zinc, and lead, to name a few of the products of western mines, are so circumscribed that these metals must "do or die" in their present applications.

From other technologies, such as atomic energy development and high-speed aeronautics, of course, will come new opportunities for materials in their present form or in easily modified form. Also, the general expansion of population and the rise in world living standards will help industries grow. But these are not enough for competitive security. New markets must be constantly investigated in order to offset the research results of competitors.

Sometimes a bit of rough sledding is just what an industry needs to revitalize it. A few years ago the future for the American textile industry looked hopeless. The industry was plagued with rising labor costs, overproduction, overcapacity, foreign imports, declining markets. Yet today the industry is in a strong rising trend, with sales and profits climbing, and with investors bidding up the prices of its equities. Why?... The foreign competition still exists, and textile workers are still clamoring for higher wages. Some of the things previously discussed are the answer. The cost reductions the textile industry achieved through modernization, the new fabrics, the new products—all these came from technical, economic, and market research—not from political action.

The July 20 issue of Barron's tells what happened to the Hamilton Watch Co. recently—it tells why Hamilton is no longer fretting about imports, but, instead, is talking of invading foreign markets. Problems of the mining industry can hardly be more intense than those this company has faced.

Research may not be the whole answer for the mining and minerals industries, but it should be a big help.

Old Wine *in* NEW BOTTLES

The day of concern for only lost time injuries—of ambulance chasing—is past. Everyone must resolve to put into practice what has been discussed for years—that is, a real job of accident prevention

By GEORGE W. HARPER
Professor of Mechanical Engineering
University of Illinois

WHY do individuals, management, and employees spend time, money, and effort in the attempt to eliminate accidents in industry? There are many answers to this question and perhaps the eight which the author will discuss are not the most important ones from everyone's viewpoint. They are, however, sufficiently broad to indicate the most important items.

WHY We Try to Prevent Accidents

Number one is *Humanitarianism.* In this country, where our way of life, religious principles, and political ethics place high value on the worth of the individual, the cornerstone of accident prevention is our interest in and concern for the other fellow. One can find this precept in writings and talks by leaders in both management and unions. While other reasons are important, and may on occasion seem to be paramount, our fundamental reason for accident prevention always goes back to the respect and concern for the individual.

The second reason is the *direct cost of injuries.* These are the costs which are usually charged to the injury involved and may be paid through workmen's compensation insurance, a state fund, or self insurance. They are made up of three charges, namely—payments to the injured employee, medical costs, and in certain cases legal costs. They amount to thousands upon thousands of dollars every year.

Third is an even greater expense—*indirect cost of injuries.* In this category are the costs of plant first aid service; time lost by co-workers to help the injured person; time lost to replace the worker; time lost by the supervisor to adjust schedules, train new personnel, investigate the injury, attending hearings and so forth. Piled on top of these is the psychological reaction of those who may have seen the injury and through fear or worry are not able to handle their jobs efficiently. All of these factors create costs which are hidden, but nonetheless real.

Now we come to number four—the *cost of accidents.* This cost refers to what many people call "No Injury Accidents." Ask yourself one question: "Are accidents investigated in your company?" Stop and think a moment. . . . Unless your company is an exception it is investigating injuries only; and in companies it is only the Lost Time Cases which get any real attention. One more question: What is written on top of the investigation report which you use? Does it say "Accident Investigation" or does it say "Injury Investigation?" If it says "accident" your management and employees are being sold the wrong bill of goods. Emphasis is being placed on injuries and they are being referred to as accidents.

One misuse of terminology which, in the majority of cases, is laid on the doorstep of those doing full time safety work, is that term "Lost Time Accident." It should be "Lost Time Injury," because it is not the accident, but the injury, which causes the lost time.

Everyone must begin to emphasize accidents, not just those which cause lost time cases, or only those with minor injuries, but *all* accidents. During the past 40 years, the injury frequency rate in industry has shown a continued downward trend. In fact, the record has been good enough to permit a complacent attitude to develop. It is high time many companies re-evaluate their programs and begin to do a sincere and honest job of accident prevention. If they will do this, they will see that the surface is barely scratched, or that the horizon can not be seen. If there is anything new in what the author has to say, it is to bring all concerned with safety this challenge—let's begin to think and act on accident prevention and stop being ambulance chasers, because if we stop the accidents we will automatically eliminate the injuries. Moreover, there are other reasons for having an accident prevention program and four of these are as follows: (1) *improved employer-employe relations;* (2) *better public relations;*

WHY ACCIDENT PREVENTION?

1. Humanitarianism
2. Direct Cost of Injuries
3. Indirect Cost of Injuries
4. Cost of Accidents
5. Improved Employer-Employe Relations
6. Better Public Relations
7. Good Citizenship—Obeying Safety Codes
8. Increased Production

(3) *good citizenship—obeying safety codes*, and (4) *increased production*. These are valuable results of an effective accident prevention program.

WHAT Tools Are Available to Help Do The Job

One might ask, "What do we work with in accident prevention," or "What are the tools?" To answer this question it is necessary first of all to know what the problem is. The skilled workman looks at the job and decides which tool to use; the problem of accidents must be similarly analyzed.

First of all, it must be realized that the attack must be made on the accident; and there are only three basic causes of accidents: (1) unsafe conditions, (2) unsafe acts, and (3) unsafe attitudes.

The first two of these are primary causes. When an accident is investigated it is usually easy to see that either one or the other, or sometimes both, causes are present. The third factor—unsafe attitude—is usually present and no doubt is the reason for a person committing an unsafe act, or creating an unsafe condition which may booby-trap himself or another worker. Of course, it is almost impossible to determine the unsafe attitude unless the employe himself will volunteer the information. However, it is not necessary to know the specific unsafe attitude to apply a remedy. In most instances, direct action can be taken in correcting unsafe conditions and unsafe acts—by investigating the case, analyzing the report, deciding upon the procedure, and taking action. The method in handling unsafe attitudes, since the specific cause is not known, is to supplant unsafe attitudes with safe ones—in other words, build safety consciousness.

In general Unsafe Conditions are corrected by the application of safety engineering; Unsafe Acts by training in safe practices; and Unsafe Attitudes through safety promotion techniques. In other words, there are three kinds of tools for accident prevention—Engineering, Training and Promotion. Each of these types of tools will do only one type of job, and it is a waste of effort to attempt to clear up an unsafe condition through training. This emphasis on the uses and limitations is important. Everyone, at one time or another, has used the wrong type of tool, and then wondered why he got the wrong results.

Look at this kit of tools a little closer—start with *engineering*. The author can suggest at least 10 tools for this portion of the kit. Undoubtedly, many more could be added. The second portion of the kit contains *training tools* to correct unsafe conditions. Finally in the third portion of the tool box are *promotional tools* to foster safe attitudes. Before moving on it should be pointed out that these are the tools. The question of who is responsible for putting them to work will be taken up next.

WHO'S Responsible?

There is no single answer to the question of how to use these tools because companies vary in size, in operations, and in internal organization. There is, however, a general blue print which has grown out of years of experience, and it is not new. These points can serve as a check list; a bench mark against which one may check his own safety organization and performance.

An effective method of applying these safety tools may be likened to a chair; it must have four legs to stand on, or it will not be worth using. At the same time if any of the legs are short it will be out of balance.

The first leg is *top management leadership* and, it must be added, *participation*. Directives written on water-marked bond stationery are not enough. The "big boss", whatever his actual title on the organization chart may be, must be a part of the program. He must take part; he must be seen; and his presence must be felt. This can be achieved in many ways, but space does not permit additional details. He knows what will do the job in his company—the trick is to do it!

The second leg is *supervisory responsibility*. This means that all supervisors, both superintendents and foremen, know their part in the program and that they do it. They keep their shop areas in safe condition; they give adequate job safety training and they follow-up; and they realize that a man's attitude toward his job and toward his supervisor may be as important as his ability and skill on the job.

The third leg is *employe participation*. When the average "Joe" on the job says, "This safety is for me," the result is a successful program. Every employe has to have a place in, and feel he is a part of the program. Ask yourself one question; "How do the people in our plant feel toward our program?"

And now for the last leg of the chair—*delegated safety authority*. To the author this means that there is an individual group or person who sparkplugs the safety program, but it does not mean that all responsibility for safety is centered in one place. In large organizations this may mean a department with several persons, or it may mean only one. In small plants it may be part of a person's work. Please notice it was not described as a "part-time" job. In every case there must be a center for safety information and assistance to top management, supervisors, and employes.

The day of concern for only lost time injuries—of ambulance chasing—is past. Everyone must resolve to put into practice what has been discussed for years—that is, a real job of *accident prevention*.

WHAT ARE THE TOOLS?

Unsafe Conditions *CORRECTED BY ENGINEERING*	Unsafe Practices *CORRECTED BY TRAINING*	Unsafe Attitudes *CHANGED THROUGH SAFETY PROMOTION*
1 Plant Layout	1 General Safety Rules	1 Advertising
2 Machine Guarding	2 Induction Training	2 Posters
3 Handling Material	3 Safety Job Analysis	3 Bulletin Boards
4 Welding & Cutting	4 Job Safety Rules	4 Signs
5 Electrical Hazards	5 Job Training	5 Stunts
6 Pressure Equipment	6 First Aid Training	6 Contests
7 Hand & Power Tools	7 Fire Prevention Training	7 Campaigns
8 Industrial Health Haazrds	8 Special Safety Classes	8 Certificates
9 Personal Protective Equipment	9 Foreman Training	9 Plant Publications
10 Fire Protection	10 Management Conferences	10 Suggestion Systems

HOW ARE THE TOOLS APPLIED?

1 Top Management Leadership
2. Supervisory Responsibility
3 Employe Participation
4 Delegated Safety Authority
  (A) Inspections
  (B) Investigations
  (C) Maintain Interest
  (D) Evaluation

As Viewed by Henry I. Dworshak of the American Mining Congress

UNITED States Government officials, concerned about the attrition of U. S. gold reserves resulting from adverse international trade balances, are attempting to alleviate the situation by a campaign to increase exports to other nations.

Our gold reserves have skidded from $24.2 billion in 1950 to $19.6 billion a few weeks ago—and other nations have legal claims to approximately $18 billion of this gold if they choose to convert their dollar holdings. A prominent New York banker said recently that we can expect to lose about $1 billion a year in gold as long as our imports continue to exceed exports by the current rate of $4 billion to $5 billion a year.

The U. S. delegation to the 15th meeting of the members of the General Agreement on Tariffs and Trade (GATT), being held in Tokyo, will "encourage other countries to eliminate rapidly the remaining discriminations against dollar goods and generally to reduce the level of their quantitative imports restrictions," the State Department announced.

Such action by other countries, according to U. S. officials, would increase U. S. sales by millions of dollars a year and would stimulate American traders to promote sales abroad of several types of goods now largely barred from many foreign markets. The U. S. contends that most nations, including Britain, Japan and other industrialized countries, now have enough dollars and industrial ability to allow U. S. products to enter their markets.

The International Monetary Fund is giving this campaign a push. Executive directors of the 68-nation Fund have unanimously called on the Free World's main trading and industrial countries to remove "with all feasible speed" discriminatory restrictions which have hampered U. S. exports.

If the campaign is unsuccessful, some observers foresee only two alternatives—complete repudiation of gold as a basic monetary metal, or revaluation of the dollar in terms of gold.

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Washington Highlights

ENERGY HEARINGS: Coal men testify.

MINING PROGRAM: Western Governors adopt resolution.

TAX BASE: Studied by Ways and Means Committee.

TVA: Awards long-term coal contract.

MINERAL SEARCH: Government approves contracts.

SOLAR ENERGY: Agencies see little need for research.

★ ★ ★ ★ ★ ★

COAL MEN TESTIFY AT ENERGY HEARINGS

Two well-known spokesmen for the domestic coal mining industry were among the many witnesses who testified during a week of hearings in mid-October conducted by the Senate-House Economic Subcommittee on Automation and Energy Resources. The hearings were part of a broad study of energy resources undertaken earlier this year by the Subcommittee.

George A. Lamb, manager of business surveys, Consolidation Coal Co., Pittsburgh, forecast that America's growing energy requirements will increase demand for bituminous coal by 80 percent in the next two decades. But at present, he warned, the coal industry's production capacity is declining and is below the level necessary for adequate emergency production and normal peacetime growth.

He attributed current conditions in the industry largely to impingement on coal's traditional markets by "dump" sales of natural gas and foreign residual oil. "Oil and gas can dump because they can recover price losses incurred by dump residual oil and off-peak gas sales through increased prices on other sales free from coal competition," he explained.

Lamb's forecast of a tremendous increase in total energy requirements concurred with analyses presented earlier to the Subcommittee by Government officials and spokesmen for the utilities and other industries. He also declared that coal, as a solid fuel and by conversion through synthesis into liquid or gaseous fuels, can "be the source for satisfying most all of the country's energy needs." Recoverable coal reserves are sufficient to satisfy total U. S. energy requirements for three centuries at the estimated rate of consumption in 1980, he added.

Following Lamb on the witness stand was Joseph E. Moody, president, National Coal Policy Conference. Moody, who is also president of the Southern Coal Producers Association, devoted the bulk of his testimony to support of a proposed Congressional inquiry aimed at establishing a national fuels policy—an inquiry which would be authorized by a resolution now pending in Congress.

Moody noted that for two decades "every commission, committee, or study group that has dealt objectively with America's energy resources has urged that an integrated fuels or energy policy be adopted by the Government." He presented these reasons for such a policy: (1) Maintenance of a strong, dynamic energy base "is one of the most essential ingredients

of our national security"; (2) "the United States is involved in international competition . . . and this competition demands healthy, vigorous energy industries which will permit our Nation to realize the maximum benefit from its growth potential"; and (3) factors growing out of the lack of a national fuels policy "are already tending to distort our domestic economy."

WESTERN GOVERNORS APPROVE MINING RESOLUTION

Reaffirming an intense interest in the domestic mining industry, the bipartisan Conference of Western Governors has adopted a broad resolution in support of a long-range minerals program for the nation. Meeting at Sun Valley, Idaho, late in September, the Governors declared that this program is necessary if the domestic mining industry is to continue its traditional role as the arsenal of defense and a mainstay in the economy of the West and the entire country.

Aimed at both the Administration and Congress, the resolution calls for (1) an adequate national minerals policy to assure a healthy domestic mining industry; (2) the taking of all steps needed to assure the domestic mining industry of at least one-half of the domestic market, or the present proportion of the domestic market (whichever is higher), either by adequate tariffs, excise taxes, or quotas, or in the case of the minor metals, allocation of import receipts or such combination of these as may be most suitable; (3) appropriation of Federal funds for the Department of Interior to establish and accelerate an inventory of mineral resources of the United States through a thorough mapping, exploration, and geologic program; and (4) initiation by the Government of a joint and cooperative examination of the mineral resources of the Free World to the end that an inventory of those resources be made and policies adopted for their economic production, distribution, and marketing.

The resolution also urged that (1) there be no decrease in present depletion or depreciation rates in the Federal tax structure; (2) additional exploration be encouraged by removing the present limitation on tax-deductible exploration; (3) the Buy American Act be strictly followed on a national basis, and a similar policy be made equally applicable, where possible, on a State basis; (4) barter of surplus agricultural commodities for the procurement of current Government agency requirements be halted; (5) mineralized areas not be locked up in wilderness areas or other Federal reserves; (6) a study be made to determine whether the principle of multiple use of public lands is being carried out by the Federal Government; (7) legislation be enacted providing that all revenue from mineral leases on public lands in excess of the cost of administration revert to the State of origin; and (8) research in the mineral field at all levels be accelerated.

HOUSE COMMITTEE STUDIES FEDERAL TAX BASE

The House Ways and Means Committee, Congressional fountainhead of Federal tax laws, is engaged in a comprehensive study of these laws in order to determine whether the tax base can be broadened as the basis for a general reduction in rates. In connection with its study, the Committee has enlisted the aid of specialists in various fields.

Part of the over-all project will be a public hearing in Washington December 1 on "percentage depletion and exploration and development costs." The Committee has invited witnesses from the mining and oil and gas industries, as well as several university professors, to testify at that time; the witnesses will present their individual views and will not speak for any organization.

These witnesses from the mining industry were invited to participate in the December 1 hearing: Rolla D. Campbell, general counsel, Island Creek Coal Co., Huntington, W. Va.; Herbert C. Jackson, managing partner, Pickands Mather & Co., Cleveland, Ohio; and L. J. Randall, President, Hecla Mining Co., Wallace, Idaho.

TVA AWARDS HUGE COAL CONTRACT

The Tennessee Valley Authority announced last month the awarding of the largest coal contract in its history —in terms of both tonnage and dollar value—to Peabody Coal Co. of St. Louis, Mo. The contract calls for the delivery of 65 million tons of coal over a period of 17 years for a total of $191,750,000.

The coal will be used to supply a new steam-electric generating plant in Western Kentucky to be built at a cost of more than $100 million. This plant will be financed by public sale of TVA revenue bonds authorized by a recently enacted law. Deliveries of coal are scheduled to begin in August 1962.

TVA also awarded a number of other long-term coal contracts covering periods ranging from five to 15 years. Companies getting contracts, which call for a total of 23 million tons, include West Kentucky Coal Co., Coiltown Mining Co., Bradford Coal Co., Kentucky Oak Mining Co., and Intermountain Coals, Inc. The latter company's contract was made on a conditional basis, and the coal will be mined by Pocahontas Fuel Co.

GOVERNMENT APPROVES MINERAL EXPLORATION CONTRACTS

The Interior Department's Office of Minerals Exploration received 57 applications for minerals-exploration assistance during the first six months of 1959 and entered into eight contracts with mining operators for such assistance, the agency announced in its semiannual report to Congress.

Covering exploration for five minerals in seven States, the eight contracts called for aggregate expenditures of $180,950, with the Government's share set at $90,295, or approximately one-half of the total. Remainder of the funds will be furnished by the contracting operators.

Twelve of the applications were denied because of the geological improbability of making a significant discovery, OME reported. Action on the remaining applications had not been completed as of June 30.

Congress last year authorized establishment of the Office of Minerals Exploration as part of a program for the discovery of mineral resources, excluding organic fuels, in the United States and to provide Federal financial assistance to private industry on a participating basis for that purpose. OME also administers exploration project contracts executed by its predecessor agency, the Defense Minerals Exploration Administration, which was set up under the Defense Production Act of 1950. DMEA became defunct June 30, 1958.

Where an OME exploration contract results in a discovery certified as such by OME, the Government's portion of expenditures under the contract is repayable by the mining operator, with interest, in the form of royalties to the Government on any subsequent production.

SOLAR ENERGY RESEARCH SEEN NOT VITAL

At the request of the Senate Interior Committee, several Government agencies have submitted their views on a bill by Senators Bible and Cannon (Dems., Nev.) to provide for re-

(Continued on page 90)

personals

John R. Palin has been appointed chief engineer for Pittsburgh Coal Division, Consolidation Coal Co., succeeding **C. M. Hays.** Hays has retired after 33 years of service with Pittsburgh Coal and predecessor companies.

Palin began his mining career in

J. Palin

C. Hays

1937 with Goodman Manufacturing Co. and then worked a short time with Baton Coal Co. before joining the Air Force during World War II. In 1946 he joined Consumers Mining Co., later Harman Coal Co., and has been assisting Hays for the past several years.

Hays went to work for H. C. Frick in 1911 and, following service during World War I, joined Republic Steel Corp. In 1926 he went with Union Collieries, becoming chief engineer for them in 1934, and joined Pittsburgh Coal at the time of the Pittsburgh Consolidation merger in 1945.

Frank W. Chambers has been appointed executive vice president of Strategic Materials Co. He has been director of engineering, Kennecott Copper Corp.

J. Davidson Van Note has been elected vice president for sales, Blue Coal Corp., a division of Glen Alden Corp. Van Note has been with Blue Coal since 1947.

John A. Coe has been elected a vice president of Anaconda Co. Coe, chairman of the board of directors of American Brass Co., has been associated with the Anaconda subsidiary since 1920.

William L. Affelder has been elected president of Emerald Coal and Coke Co. and of its fully-owned subsidiary, Emerald Land Co., succeeding the late **J. L. Hillman, Jr.** The former company operates the Emerald Mine in Greene County, Pennsylvania, one of the largest mines in the state. He also continues as a vice president of J. H. Hillman & Sons Co.

Joseph B. Elizondo has joined White Pine Co. as planning engineer. He was formerly general superintendent of Eagle-Picher Company at Miami, Okla.

Dr. Donald S. Arnold has been named manager of research at American Potash & Chemical Corporation's main plant at Trona, Calif. He succeeds **Dr. Donald E. Garrett** who has resigned to enter his own business.

Stephen F. Dunn will become president of the reorganized national Coal Association—effective around January 1, 1960. He has resigned as vice president in charge of government relations of the National Association of Manufacturers to accept the new position. Dunn had been with NAM since June 1957.

William G. Hewitt has been appointed assistant to the president of the Bunker Hill Co. Hewitt joined Bunker Hill in October, 1958 as marketing analyst and will continue to work with problems in marketing. Previously, he had been president of Pacific Guano Co.

Nicholas J. Kockler has been named public relations director, United States Borax & Chemical Corp. For the past four years, Kockler has been assistant industrial relations director of the firm's United States Potash Division.

Benjamin F. Fairless has been elected a director of the Guyan Eagle Co., Huntington, W. Va. He is former president and board chairman of U. S. Steel Corp. and is currently serving as a member of the steel company's executive committee and board of directors.

William N. Matheson has been appointed executive vice president of Oliver Mining Division, U. S. Steel Corp. Matheson had been Oliver's vice president in charge of operations since 1956, and was responsible for production of iron ores and concentrates from Oliver's mines and ore processing plants. He has been associated with the company for 26 years.

S. Richard Pursglove and **Robert W. Berta** have been appointed vice presidents of Pittston Clinchfield Coal Sales Corp., a division of the Pittston Co.

Ivor G. Pickering has been named general manager of Kennecott Refining Corporation's new electrolytic refinery near Baltimore, Md. Pickering has been employed by Kennecott since 1939 and previously had served as project engineer of the new facility.

Charles L. Howlett has been appointed manager of the Alpena mill of Huron Portland Cement Co. Howlett, former assistant mill manager, succeeds **William G. McDonald,** who has retired but is being retained as a consultant on community relations.

Arthur J. Weinig, Jr. has been appointed assistant chief engineer, United States Borax & Chemical Corp. He will supervise design and process development activities at the company's Carlsbad, N. M. operations.

Robert Ammon has been appointed director of milling and mineral beneficiation activites of all mining operations, American Zinc, Lead & Smelting Co.

Stanley W. Holmes, chief geologist, Consolidated Denison Mines, Ltd., has been appointed head of the firm's newly-created exploration division.

Dr. Charles A. Anderson has been named administrative geologist

Mineral Deposits Branch, and chief of the Geologic Division, U. S. Geological Survey. Dr. Anderson taught at the University of California for 16 years prior to joining the Geological Survey in 1942. He first served as assistant chief and later as chief of the Mineral Deposits Branch.

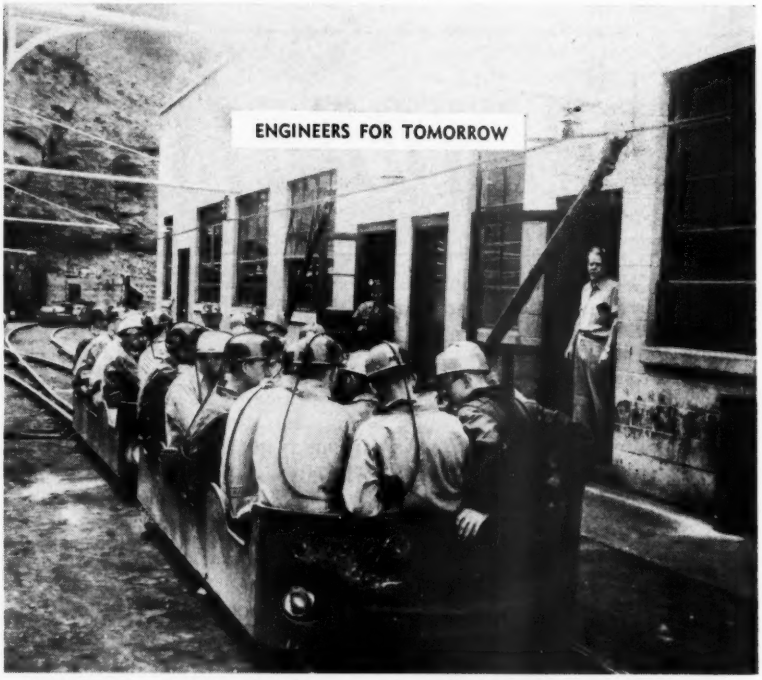
Harry E. Nelems has been appointed mine manager of Kermac Nuclear Fuels Corp., Grants, N. Mex. Previous to the appointment Nelems had been retained by Kermac on a consulting basis.

The formation of a consulting partnership under the name of Borcherdt & Smith, Mining Consultants, has been announced. **E. R. Borcherdt,** who has retired as director of mining research of the Anaconda Co., and **C. DeWitt Smith,** mining engineer and a former vice president of Copper

C. Smith

E. Borcherdt

Range Co., will offer consulting services in mine management and operations, mine plant planning and layout, and evaluation of mining properties. Their main office is at 369 Pine St., San Francisco.



Students tour a Pocahontas Fuel Co. mine at Itman, W. Va. under a program sponsored by WAAIME

Under the supervision of Mrs. Harry F. Lawrence, chairman, National Secondary School Student Counseling and Guidance Committee, the Western Pennsylvania Section, Women's Auxiliary to the AIME, has begun the second phase of a program aimed at attracting outstanding, science-minded young men into engineering with emphasis on the mineral industries.

In cooperation with industry and several universities, the Western Pennsylvania Section last summer undertook to expose high school juniors to the challenges of engineering through a series of tours intended to give an accurate picture of opportunities in mining, metallurgy and petroleum.

Forty-eight boys from a group of 129, representing 43 high schools in western Pennsylvania and northern West Virginia, were selected by examination to participate in the tours.

Split into four groups, the boys were taken on four different five-day trips during the summer, which included visits to underground and surface mines, mills, preparation plants, research laboratories, industrial mineral plants, mining equipment manufacturing facilities, and the mineral industry departments of the cooperating schools.

The tours are being followed up with literature, lists of accredited schools and recommended readings, as well as scholarship and loan program information to further stimulate interest in careers in mining and related fields.

Because of the success of the Western Pennsylvania Section project, several other sections of WAAIME have been inspired to initiate programs that will encourage youngsters to study the earth sciences.

OBITUARIES

William Collins, 90, a former partner of M. A. Hanna Co., died October 4 at his home in Cleveland Heights, Ohio.

Mr. Collins, retired dean of coal shippers on the Great Lakes, had joined M. A. Hanna Coal & Dock Co. in the early 1900's. When the company was incorporated in the 1920's he was elected a director.

Churchill Gear Sheldon, 71, retired sales engineer for the Ingersoll Rand Co., died September 17 in a Salt Lake City hospital.

Mr. Sheldon began his mining career in 1909 with the Chino Copper Co., New Mexico. He later served as a mining engineer for the Mesabi Iron Co., then as chief engineer for the Munro Iron Mining Co. He joined Ingersoll Rand in 1920.

Robert Livermore, 83, retired mining engineer and mining company executive, died in Boston, Mass., September 27.

Mr. Livermore had engaged in mining exploration in Nevada and Colorado in the early 1900's and served in the Army during World War I. He founded North American Mines, Inc. and served as vice president of the company until his retirement in 1947. He was a former vice president and director of Calumet & Hecla Consolidated Copper Co.

John Hartwell Hillman, Jr., 79, president of Hillman Coal & Coke Co., died of a heart ailment Sept. 25 in Pittsburgh.

Mr. Hillman had organized S. H. Hillman & Sons Co., a coal and coke brokerage business in 1913. Later, the company purchased coke plants and operated 15 mines. In the 1940's he organized the Texas Gas Transmission Corp. and at the time of his death was serving as board chairman of the firm.

R. H. Hughes

The 1960 Coal Convention

Scene Will Change

Pittsburgh, Pennsylvania, will be the scene of the 1960 Coal Convention of the American Mining Congress next May 9–11. Not since 1933, when a combined Coal Convention and Exposition was held there, has the American Mining Congress returned with its Annual Coal Convention to the coal, iron and steel capital of the world, and plans are moving ahead rapidly for what is expected to be one of the finest Coal Conventions ever held.

Under the Chairmanship of R. H. Hughes, President, Clinchfield Coal Company, the Program Committee will meet shortly to select subjects and speakers for the Convention. Made up of a wide cross-section of the coal industry—including operators from all of the large coal fields, representing both deep and strip mining, together with a representative group of mine equipment manufacturers—the committee is responsible for putting together a program that will bring the industry up-to-date on general industry problems as well as on all phases of coal mining, preparation and safety.

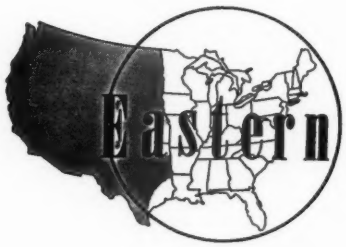
The yearly Coal Convention of the American Mining Congress is widely recognized as a forum where the broad economic problems of the industry are considered and the most recent advances in mining technology and equipment are thoroughly discussed. These meetings have charted the coal industry's progress over the years, and the 1960 Convention will continue this worthy tradition.

A tentative outline of the program put together by the committee at its November meeting will be published in the December issue of Mining Congress Journal—watch for it.

Members of Program Committee

R. H. Hughes (*Chairman*), Clinchfield Coal Co.
George C. Breidenbach, T. J. Gundlach Machine Co.
Cletus A. Broecker, Ayrshire Collieries Corp.
J. Allan Brookes, Mather Collieries, Pickands Mather & Co.
Stephen Canonico, Clinchfield Coal Co.
Edward J. Carroll, Kennametal, Inc.
L. H. Chalfant, Bethlehem Mines Corp.
George J. Clark, Reading Anthracite Co.
Charles W. Connor, U. S. Steel Corp.
Jesse F. Core, U. S. Steel Corp.
R. J. Craig, Rochester & Pittsburgh Coal Co.
Jefferson J. Davis, Electric Steel Foundry Co.
Charles B. Elledge, General Electric Co.
J. A. Erskine, Eastern Gas & Fuel Associates
P. P. Ferretti, Pocahontas Fuel Co.
R. W. Fox, North American Coal Corp.
A. G. Gossard, Snow Hill Coal Corp.
Cecil Guthrie, Peabody Coal Co.
H. J. Hager, Alabama By-Products Corp.
W. H. Haley, Caterpillar Tractor Co.
J. L. Hamilton, Island Creek Coal Co.
Henry Harnischfeger, Harnischfeger Corp.
H. John Harper, Eastern Gas & Fuel Associates
C. T. Hayden, Sahara Coal Co.
Robert G. Heers, Kaiser Steel Corp.
G. R. Higinbotham, Mountaineer Coal Co.
James Hyslop, Hanna Coal Co.
David Ingle, Jr., Ingle Coal Corp.
C. O. Kane, Armco Steel Corp.
Ralph E. Kirk, Kirk & Cowin, Inc.
Ralph Kress, LeTourneau-Westinghouse Co.
John W. Krous, Imperial Coal Corp.
E. B. Leisenring, Jr., Stonega Coke & Coal Co.
John S. Marshall, Pierce Management Corp.
H. E. Mauck, Freeman Coal Mining Corp.
James G. McCurry, Imperial Smokeless Coal Co.
D. L. McElroy, Consolidation Coal Co.
Joe L. McQuade, Donegan Coal & Coke Co.
E. M. Pace, Inland Steel Co.
John A. Persinger, Acme Machinery Co.
Edwin R. Phelps, Pittsburg & Midway Coal Mining Co.
E. P. Reed, U. S. Steel Corp.
John J. Reilly, Jones & Laughlin Steel Corp.
George L. Roberts, Simplex Wire & Cable Co.
F. E. Rosenstiehl, Texaco, Inc.
O. A. Schilling, Goodyear Tire and Rubber Co., Inc.
R. H. Seese, Berwind-White Coal Mining Co.
S. F. Sherwood, Sherwood Templeton Coal Co.
H. H. Smith, National Malleable & Steel Castings Co.
Dr. N. B. Sommer, American Cyanamid Co.
J. B. Taggart, Wise Coal & Coke Co.
C. B. Tillson, Jr., Crucible Steel Co.
D. W. Vernon, John A. Roebling's Sons Corp.
Charles Vignos, II, American Mine Door Co.
C. E. Walker, Jewell Ridge Coal Corp.
W. L. Wearly, Joy Manufacturing Co.
R. R. Williams, Jr., Colorado Fuel & Iron Corp.
J. A. Younkins, Duquesne Light Co.

NEWS and views



World's Biggest Engineering Center

Ground breaking ceremonies for the United Engineering Center, a multi-million dollar 18-story structure to be erected opposite the United Nations in New York City, was held October 1. Former President Herbert Hoover, representing the older generation of engineers, shared earth-turning honors with a freshman engineering student from Hawaii, Jerry Fujimoto, representing engineers of the future.

The Center will house the headquarters of 18 major engineering societies with a combined membership of more than 300,000. Scheduled for completion in mid-1961, the structure will be the largest undertaking ever attempted by the engineering profession.

Andrew Fletcher, president of St. Joseph Lead Co., is president of United Engineering Trustees, the organization that will own and operate the structure on behalf of the engineering societies. He said that, "the primary purpose of the new structure is to provide adequate working space for the headquarters staffs of the engineering groups, which carry on extensive publishing, research and standardization programs." The second purpose, he added, "will be to symbolize the growing strength and growing unity of the engineering profession."

Peabody to Open New Mine

The new Tennessee Valley Authority power plant at Paradise, Ky., will result in the opening of a large new strip coal mine nearby. The new mine, which Peabody Coal Co. will operate, will produce 4,000,000 tons a year. No definite date has been set for opening the mine.

TVA recently announced the awarding of a contract to Peabody for delivery of 65,000,000 tons of coal to the plant during the next 17 years.

Lithium Corp. Terminates Quebec Lithium Contract

Lithium Corp. of America, Inc., has announced that it has terminated a raw materials purchase contract with Quebec Lithium Corp. and that it would not accept any further deliveries of spodumene ore concentrates from Quebec Lithium. Lithium Corp. of America intends to resume mining its own North Carolina ore in 1960, when its present inventories of concentrates and raw ores will have been exhausted.

Lithium Corp. also stated that preparations for moving its St. Louis Park, Minn., production facilities, research and development laboratories, and pilot plant to Bessemer City, and of moving its executive offices to the eastern seaboard are proceeding on schedule. Construction of the new facilities at Bessemer City is underway, with production expected to begin about January 15, 1960.

First-Aid Contest Held in West Virginia

One of the largest area first-aid contests staged in the nation this year was held at Beckley, W. Va., on August 22. Competing for prizes in the first five positions were 35 teams representing 10 southern West Virginia counties and one in Virginia.

Event was sponsored by the Fayette Raleigh Wyoming First-Aid League, comprised of officials representing the coal operators, United Mine Workers of America, and State and Federal agencies in southern West Virginia. Joshua Smith, director of safety for Eastern Gas & Fuel Associates, served as chairman and James Leeber, Jr., safety engineer for District 29 of the U.M.W.A., was treasurer of the league.

The team from Itmann Mine, of Pocahontas Fuel Co., captured first place. Second and third place went to Holden Mine No. 27 and the Wyoming Mine, both of Island Creek Coal Co.

Bauxite Carrier Completes 100th Voyage

The S. S. Richard, world's largest self-loading bauxite carrier, recently completed her 100th voyage to Reynolds Metals Company's alumina plant near Corpus Christi, Tex. The ship has delivered in excess of 3,100,000 long tons of Jamaica bauxite in its first 100 voyages.

The Richard's sea time between Jamaica and Texas is about three days and eight hours; thus the vessel can deliver a cargo about every 7½ days. Her 12,500-hp engines give her an average sea speed of 16½ knots.

Quebec Cartier Mining Co.

Quebec Cartier Mining Co., a subsidiary of U. S. Steel Corp., has completed arrangements with a group of American and Canadian banks for the establishment of a credit which will enable the company to borrow up to $200,000,000 (U. S.) between now and December 30, 1960. The money will be used to assist in the development of a project to mine iron ore in the Lac Jeannine area in Quebec. The project includes construction of a new harbor and loading facilities at Port Cartier, a 193-mile railroad from Port Cartier to Lac Jeannine, a 60,000-hp hydroelectric plant on the Hart-Jaune River, and a large open pit mine and concentrator for the production of 8,000,000 tons of high grade iron ore concentrates per year.

ALSO . . .

Aluminum Company of America has announced plans to build a multi-million dollar research center

in Westmoreland County, Pa. Ground for the first installation will be broken within a year on a 2400-acre tract of rural land at Merwin. More than $30,000,000 has been earmarked for the project.

Truax-Traer Coal Co. stockholders have approved the cash sale of the physical properties of the company's West Virginia Division to Oglebay Norton Co. Truax-Traer ultimately intends to use the cash to expand its Illinois and North Dakota operations.

Production testing of the various units of the $25,000,000 Dundee Cement Co. plant now nearing completion north of Dundee, Mich., began in October and will continue for an indefinite period. Actual production of cement is expected to be around the first of the year. The plant will have a capacity of about 5,000,000 bbl a year when in full production.

The Pennsylvania Coal & Coke Division of Fairbanks Whitney Corp. has awarded a contract for construction of a coal cleaning plant at the No. 62 Heshbon mine near Johnstown, Pa. The plant, to be built by Roberts & Schaefer Co., is expected to be completed in November.

Lehigh Portland Cement Co. plans to proceed immediately with plans for a new $12,000,000 plant at Mitchell, Ind. The main portion of the plant is expected to be completed by early 1961.

Moran Coal Co. of Western Port, Md., has purchased a helicopter which will be used in conjunction with the company's strip mining operations in Allegheny and Garrett Counties. The helicopter will facilitate traveling from one strip mine operation to another and also will be useful in getting parts in Pittsburgh, Pa., or Baltimore, Md.

American Metal Climax, Inc., will build a refining plant at Carteret, N. J., to produce germanium metal for the electronics industry. The plant is expected to be in full operation next year.

Baltimore & Ohio Railroad Co. has ordered two 300-hp Coal-Pak Automatic boilers for its Riverside shops at Baltimore, Md. The installation, which burns bituminous coal, is the first in the United States using this package-type, automatic stoker-fired unit at high pressure. The unit was developed by Bituminous Coal Research, Inc., and has an automatic coal feed system, a water-cooled vibrating grate, forced and induced draft fans and a screw-type ash removal conveyor. A simple and reliable control system provides the complete assembly with full automation.

Alabama Metallurgical Corp. has announced it has successfully produced high-purity magnesium at its new plant in Selma, Ala. The corporation is owned jointly by Brooks & Perkins, Inc., Detroit, a major fabricator of magnesium, and Calmet & Hecla, Inc. Full production is expected to be achieved by November 11, when the Selma plant will be formally dedicated.

A 45-yd stripping shovel is being built for the United Electric Coal Co., Chicago, Ill., for installation on new mining property along the Illinois River, south of Peoria. The Bucyrus-Erie 1050-B machine is expected to be in operation next spring. The shovel weighs approximately 3,000,000 lb and will be equipped with a 113-ft boom and a 64-ft stick.

The United States remained Austria's largest supplier of coal last year despite cutbacks in coal purchases from abroad. Austria bought more than 1,400,000 metric tons of coal from the United States, 29 percent of her total imports. Poland and West Germany were the next largest sources.

Stockholders in the Flintkote Co. and Calaveras Cement Co. have approved a merger of the two concerns. Under terms of the merger, Calaveras will become a division of Flintkote.

Consolidation Coal Co. may mine coal from under 11.7 acres of the bed of the Ohio River near Cresap, W. Va., if the West Virginia Public Land Corp. gives its approval to the proposal.

Foote Mineral Co. has begun a $200,000 expansion at its electromanganese plant at Knoxville, Tenn. The expansion will provide a new laboratory building and increase production.

WHEELS OF GOVERNMENT

(*Continued from page 84*)

search into practical means for the utilization of solar energy.

The National Science Foundation said it does not believe that enactment of the measure is required at this time, a view also held by the Commerce Department and the Budget Bureau. The Defense and Interior Departments said they had no objection to its enactment.

Of particular interest is this statement in the Interior Department's report: "The total energy requirements of the United States are increasing year by year and, while this country is in a much better position to satisfy these requirements because of its coal reserves than are most other nations, this Department is of the opinion that the energy problem is so large and complex that it is desirable to explore all sources of energy, including fissionable materials as well as energy from the sun."

Baltimore & Ohio Railroad Co. has ordered two 300-hp Coal-Pak Automatic boilers for its Riverside shops at Baltimore, Md. The installation, which burns bituminous coal, is the first in the United States using this package-type, automatic stoker-fired unit at high pressure. The unit was developed by Bituminous Coal Research, Inc., and has an automatic coal feed system, a water-cooled vibrating grate, forced and induced draft fans and a screw-type ash removal conveyor. A simple and reliable control system provides the complete assembly with full automation.

Huron Portland Cement Co. has announced a major project designed to add considerably more carrying capacity to the company's fleet of six bulk cement freighters. The project involves the deepening of the channel at the Alpena, Mich., mill, the dredging of a new slip to accommodate larger vessels, and the construction of silos for the storage of 250,000 bbls of cement.

Peabody Coal Co. has purchased a wheel excavator for its River King mine near Belleville, Ill. The machine, which is expected to be in operation by mid-1960, will stand approximately 150 ft in height, 390 ft in length and 50 ft in width. Its working weight will run over 3,000,000 lb. A fast-moving dual conveyor spoil system will be fed continuously by a 24-ft diam revolving wheel equipped with nine one-yd self-cleaning buckets. Use of the dual conveyor belt system permits spoiling the material some 400 ft from the cut at a maximum dumping height of 128 ft in one continuous, non-swing operation.

NEWS and views

A 500-tpd integrated steel plant is proposed for construction at Clarkdale, Ariz., site of the United Verde copper smelter which was abandoned in 1950. Webb & Knapp, Inc., a New York firm, has purchased the facilities and plans to recover iron from copper slag for processing into steel using the Strategic-Udy direct reduction process—believed to be the first commercially feasible method developed for making steel from slag. Koppers Co. is conducting research and engineering on the project which may lead to fulfillment of plans that would call for expenditures of about $15,000,000 to build the plant. In addition to recovering the iron as steel, the process produces a so-called slag-slag which could be used as a lightweight aggregate to manufacture concrete building products or rock wool insulation.

The 552-tpd uranium mill of Federal-Radorock-Gas Hills Partners near Riverton, Wyo., has commenced operations. Construction of the $3,250,000 project was started April 1. Western-Knapp Engineering Co. designed and built the facilities which are expected to employ about 100 men.

Utahcan Mines, Inc. recently shipped its first zinc concentrate from operations near Ione, Wash. to Bunker Hill at Kellogg, Idaho. The lead-zinc property is being worked as an open pit and the firm is operating a 100-tpd mill.

Mining research at the U. S. Bureau of Mines, Spokane, Wash. office will be stepped up as a result of reorganization of USBM Region 1. Studies that will receive particular attention in the immediate future relate to rock fragmentation by cavitation, dielectric heating and ultrasonic vibrations. The Bureau is planning studies on rock pressures and ground control in the Coeur d'Alene's. This follows installation of 18 concrete mine sets at the Star, Sunshine and Page mines. Further work is also contemplated on using the Bureau's rock planer in developing it for possible application to hard rock mining. The planer has been successfully tested in mining phosphates.

The Iron King magnetite mine in Humboldt County, Nev., is being converted from open pit to underground operations. Iron King, from which about 6000 tons per month of magnetite are shipped to the midwest, has blocked out ore for underground development and expects to continue production at the same rate.

Husky Oil Co. has purchased Dickinson Briquetting Co., Dickinson, N. D. and is installing equipment for manufacturing barbecue briquettes from North Dakota lignite. The company formerly had produced only industrial briquettes.

Uranium mining is under way at Entrada Corporation's property in Ambrosia Lake district, N. M. Boyles Bros. has contracted to do the mining for Entrada and is using a modified room and pillar method. Production presently is 150 tpd from two levels, but plans call for mining at a rate of 500 tpd as soon as additional headings are developed. Boyles Bros. averaged 12.2 ft per day in sinking the 609 ft deep, three compartment shaft, and set a shaft sinking record for the district.

Jack H. How, President of Western Machinery Company and last year's chairman of the Manufacturers' Division of the American Mining Congress, and Mrs. How departed October 3rd for the Far East on a six week Trade Development tour sponsored by the San Francisco Chamber of Commerce. Mr. How, President of the Chamber, was the tour leader.

Golden Copper Queen Mining Corp. recently signed a contract with the Office of Minerals Exploration for $40,270. The company will do diamond drilling, drifting and crosscutting at their property in Lemhi County, Idaho.

Uranium ore from Prince of Wales Island, Alaska will be mined and shipped to the Ford, Wash., plant of Dawn Mining Co. this winter by JOT Mining Co.

Western-Knapp Engineering Co. has been awarded a contract to design and engineer the 15,000 tpd copper flotation concentrator for Asarco's Mission project near Tucson, Ariz. The mill will incorporate the newest metallurgical techniques, and employ many automatic measuring and control devices.

American Smelting & Refining Co. recently completed negotiations with the Small Business Administration for purchase of properties of Copper Canyon Mining Co. in Lander County, Nev. It is reported that Asarco will explore the area in an attempt to develop a profitable mining operation.

A $3,000,000 gypsum board plant is to be erected near Cody, Wyo. by Big Horn Basin Gypsum Co., with completion scheduled for 1960. Plans call for a plant capable of producing 100,000,000 board-ft of gypsum board annually. The firm will work a deposit, reported to contain between 37,000,000 and 41,000,000 tons of gypsum, by the open pit method.

STATEMENT, REQUIRED BY THE ACT OF AUGUST 24, 1912, as amended by the acts of March 3, 1933 and July 2, 1946 (Title 39, United States Code, Section 233) showing the Ownership, management and circulation of MINING CONGRESS JOURNAL, published monthly at Lancaster, Pa., for October 1, 1959.

1. The names and addresses of the publisher, editor and business manager are:

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Managing Editor, George W. Sall, Washington, D. C.

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2. The owner is: The American Mining Congress—a corporation, not for profit, Washington, D. C. No stockholders. President, Raymond E. Salvati, Huntington, W. Va.; Executive Vice-President, Julian D. Conover, Washington, D. C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

ROBERT W. VAN EVERA,
Editor.

Sworn to and subscribed before me this 1st day of October, 1958.

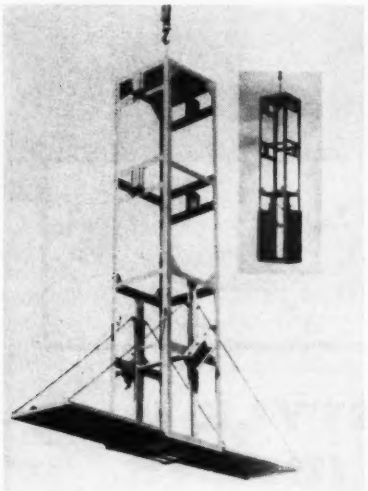
KATHRYN A. HATHAWAY,
Notary Public.

(My commision expires July 31, 1962.)

manufacturers forum

Timbering Cage

FOR SHAFT TIMBERING OPERATIONS, the Lance Timbering Cage is designed for transporting a full set of timber down the shaft, with provisions for converting the timber



skip into a staging when in position. The complete shaft set, steel or frame, is loaded on the skip including wall plates which are hung vertically on each side. The cage with doors folded is lowered to the desired working level. Doors of the cage are then lowered to a horizontal position providing a work staging. Wall plates are swung into position and from the confines of the cage, now serving as a staging and timber storage area, a crew of two men can position shaft sets. For further information, write to Machinery Center, Inc., P. O. Box 964, Salt Lake City 10, Utah.

Aluminum Mine Car

MOUNTED ON FOUR-WHEEL TRUCKS, like those used on railroad cars instead of a two-wheel assembly usually operated in coal mines, an experimental mine car is being built of aluminum plate by the Irwin-Sensenich Corp., Irwin, Pa. For use in West Virginia coal mines, the experimental unit will permit greater haulage capacity per trip, with a weight saving between 1 and 1½ tons, and lower power consumption by mine locomotives. The unit will have a 28-ft over-all length, a 7-ft width, with aluminum plate siding 4½-ft high. Maximum load of the car will be 18 tons.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed.

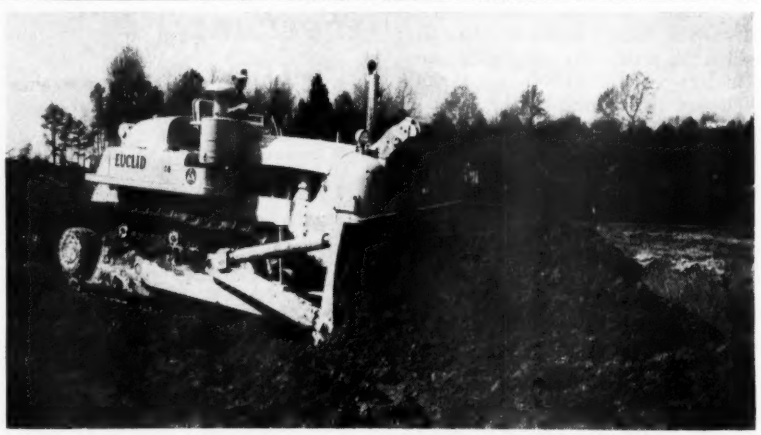
For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Loader

FOR INTERMEDIATE AND HIGHER SEAMS OF COAL, Goodman Mfg. Co., Halsted St. and 48th Place, Chicago 9, Ill., has added a 38 in. height loader. Typed as the 967 it has a rated capacity of 15 to 20 tpm and features a deep 30-in. wide conveyor, a 2¼-in. pitch conveyor chain, 4½ ft ground contact of the 12-in. wide treads and four motors—each 21 hp d-c, 26 hp a-c. The 967's power and stability also suit it for loading in potash and gypsum mines, according to the manufacturer.

Nylon Cable Splicing Guard

A SHEET OF LIVE RUBBER filled with strong nylon cords running parallel lengthwise of the sheet is the basis of this cable splicing guard which is available in 15-ft rolls in widths of from 4 to 12 in. Some of the important advantages claimed for its use are: restoration of original strength to cable after splicing; waterproofing of splice; reinforcement of cable by keeping tapered ends of splice from working loose; increases life of splice, and reduces splicing costs. More complete details as to its application will be furnished by writing to Mine Specialty Co., Boonville, Ind.



Crawler Tractor

A NET HORSEPOWER OF 211 and a Torqmatic drive consisting of torque converter and semi-automatic transmission are said to be major features of Euclid's Model C-6 tractor. Changes from one of the three forward speed ranges to another, and from forward to reverse and back again are made under full engine power. The rear mounted cooling system reportedly results in cleaner operation and permits close mounting of front end attachments. Easy accessibility for servicing is stressed by the manufacturer as an important design feature.

Literature and detailed specifications are available from the advertising department of Euclid Division, General Motors Corp., Cleveland 17, Ohio.

High-Tenacity Grease

PROVIDING A HIGHLY ADHESIVE lubricating film, Keystone No. 29 open gear grease reportedly reduces wear, increases gear life, and lowers power consumption on strip mining, quarrying, excavating and earth moving equipment.

Recommendations made for it include: retention of adhesiveness even under severe dust conditions, a wide temperature operating range permitting it to be applied without heating in cold weather. It is supplied in cartriged form and can be applied by the operator using a gun applicator.

Further information is available from Keystone Lubricating Co., 3100 N. 21st St., Philadelphia 32, Pa.

Tire Maintenance Hand Tools

EQUIPPED WITH durable, shock-resistant handles, and of rugged construction are the hand tools designed for maintenance of tires on off-the-road equipment just announced by Dill Mfg. Co., 700 East 82nd St., Cleveland 3, O.

Tools are available individually or in a packaged kit and include: hex valve cap tool, valve stem refacer, two models of valve stem rethreaders ,valve stem reseater, screw driver, valve inside extractor, screw driver valve cap tool. They are said to be designed for particular use in awkward repair positions.

Stripping Tool

TO REMOVE THE RUBBER cover from high pressure hoses prior to assembling the fitting, Aeroquip Corp., Jackson, Mich., has developed the F-2282 Hose Cover Stripping Tool. It can be used either in a standard shop vise, lathe chuck, drill press, or an Aeroquip assembly machine.

Although the rubber cover can be removed by hand with a knife, the new tool is reported to facilitate the operation, especially when large quantities of hose assemblies are needed. It is available for hose sizes – 4 through – 32. Each tool is assembled and preset for the particular size hose. For further information, request IEB – 43 from the Advertising Dept., of Aeroquip Corp.

Floating Suction Strainer

LIGHT, COMPACT AND CONVENIENT and readily fitted to the end of the suction hose is the Dolphin strainer manufactured by Megator Pumps & Compressors, 930 Manchester Ave., Pittsburgh 12, Pa. to meet the needs of pump users in drawing from streams, ponds, sumps or for de-watering mines, quarries and excavations.

It is made in four sizes, for 1½ in., 2 in., 3 in., and 4in. hoses, and is constructed from plastics and austenitic stainless steel, making it immune, for most practical purposes, from corrosion. Since the plastics used are of an extremely tough and resilient type, the strainer is reported to be capable of withstanding very rough handling, and its rounded shape, flat bottom and freedom from projections make it well adapted to being hauled about on the end of the hose.

Its floating ability is due to a balance and buoyancy of its parts, and by the fact that the tube to which the hose is directly attached can rotate freely in the body of the strainer. The float chamber is filled with a molding of expanded polystyrene "foam" which provides millions of separate water-tight air cells so that buoyancy cannot be lost as a result of accidental damage.

50-Second Test For Carbon Monoxide Poisoning

How the extent of carbon monoxide concentration in the blood stream can be measured in less than a minute is illustrated in this photo. Subject exhales into specially-designed balloon, while instrument stands ready for test. With air trapped in balloon, a chemical indicator tube is inserted into balloon mouthpiece and connected to an aspirator bulb. A controlled amount of the sample is drawn across the tube, which changes in color from yellow to a shade of green in direct proportion to the concentration of CO in the sample. Reference to a conversion table gives the actual percentage of CO in the subject's blood. The equipment is available from Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

Dust Collector

ESPECIALLY DESIGNED TO BE FREE FROM PLUGGING for use in cement plant application, a vertical tube mechanical dust collector, is now available from American-Standard Industrial Division, Detroit 32, Mich.

Designated the American Blower Series 345 dust collector, the new unit contains 15-in. vertical steel inlet tubes designed with an engineered tapered outlet which reportedly provides optimum efficiency and minimum maintenance in problem dust collection installations. It is factory assembled, of all-welded construction and its design utilizes the sectionalized concept whereby each unit is built up as a combination of collector sections to meet a specific set of dust collection requirements.

Carbide Insert Drill Bits

AVAILABLE IN THREE SIZES—1⅜ in., 1½ in. and 1⅝ in.—the one-use carbide insert drill bit has been announced by Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wis. These dust collecting bits are of the cross-type, five-hole design and can be used interchangeably on the same ⅞-in. steel with Le Roi's all-steel one-use bits. A CRD 875 shim, also interchangeable for all three bit sizes, is used for easy bit removal. Because of their low per unit cost, the bits are intended to be thrown away when they are finally dulled, according to the manufacturer.

Explosion-Resistant Safety Lamp

ULTRA-HIGH-INTENSITY ILLUMINATION, supplied by a 65,000 candlepower aircraft landing light, is a major feature of the Jetlite, according to Burton Mfg. Co., 2520 Colorado, Santa Monica, Calif. The lamp provides relatively shadow-free spots of approximately 2500 ft-candles at 3 ft and 1500 ft-candles at 5 ft—with a minimum lamp-life of 100 hrs.

The unit, which includes a 36-ft cord and transformer, is completely sealed in heavy, vulcanized neoprene rubber. This, it is claimed, provides reliable performance in any weather condition and safeguards against sparks and shorts when the lamp is used in highly volatile situations. Another recommended feature is its lightweight and small size enabling it to be handled as easily as a flashlight.

Discharge Mining Skips

A DOOR THAT PIVOTS from the top is claimed to be the "different" feature of a new frontdischarge mining skip recently announced by Lake Shore, Inc., Iron Mountain, Mich. The door is actuated by a special toggle linkage system which forces the door against a rubber seal when closed, thus eliminating spillage possibilities and completely watertighting the skip.

The main dump rollers of the skip are locked in position by safety hooks to insure positive locking during normal travel in the shaft. Another reported desirable feature is an enclosed chute extension when the skip is in the dumped position.

New Line of Crawler-Tractors

THE FIRST PRODUCTION UNIT of the new Eimco 103 line of crawler-tractors recently rolled off the assembly line, according to The Eimco Corporation's Tractor Division, P. O. Box 300, Salt Lake City 4, Utah.

The 103 line of crawlers is a 100-hp tractor and will be produced as a bare tractor, six models of dozers, a front end loader, special steel mill front end loader, and a log loader. Reported features include Eimco's exclusive up-front operator position and the use of Eimco-developed unitized "stress flow" construction, whereby massive steel castings are molded to the shapes and stress patterns required for maximum strength and rigidity, without welds or bolts. Eimco's Quadra-Torque is teamed with a heavy duty torque converter and Unidrive transmission, permitting four gear selections in either forward or reverse and allowing shifts from any speed—or from forward to reverse and back again.

The RotoPamic air cleaner of Farr Co., P. O. Box 90187, Airport Station. Los Angeles 45, Calif., is standard equipment on the Eimco 103 series tractors. The RotoPamic is a two-stage filter system, combining a centrifugal separator with a special paper aftercleaner. The air cleaner is claimed to have a constant efficiency over 99 percent regardless of airflow, weather and dust conditions, or angle of operation.

Bit Grinder

A SELF-CONTAINED UNIT designed for grinding large bits with controlled grinding-wheel movement to finish all surfaces accurately has been introduced by Gardner-Denver Co., Quincy, Ill. Called the G6 Bit Grinder, it is to be utilized basically to sharpen the larger detachable bits with G-D 600, 700 and 1000 series threads and Mole-Dril bits, but can also be used for small sizes such as Timken A, D and K. The machine grinds either "Cross" or "X" bits and has a fast, simple interchange to fixture for gauge grinding.

At Fort Knox, Ky., the U. S. Army previewed a new type of off-road transport vehicle for the Military. Named the "GOER" it is capable of delivering military supplies over rough terrain and floats across inland waterways. Developed by earth-moving manufacturer LeTourneau-Westinghouse Co. of Peoria, Ill., 15-ton machine tackles mud and water with ease.

—ANNOUNCEMENTS—

Edwin P. Boyer was recently elected vice president of production of **John A. Roebling's Sons Corp.,** a subsidiary of the **Colorado Fuel & Iron Corp.** He fills the post of **William C. Ridge** who was recently elected executive vice president.

Martin B. Friedman has been named manager of the Advertising & Promotion Department of **American Cyanamid Company's Organic Chemicals Division.** He will direct the advertising and promotion of the division's products to the rubber, chemical, plastics, paper, explosives and mining industries.

Joy Mfg. Co. has made known certain personnel changes. **Kenton E. McElhattan** has been named product manager, miners and loaders. He is responsible for the standard line of Joy miners and loaders, as well as Joy's new "pushbutton" miner.

Edwin C. Cooney was named manager, hoist and loader department; and **Bryan J. Dickinson,** manager, tungsten carbide bit department.

Kingdon B. Dietz has been promoted by **Colorado Fuel and Iron Corp.,** from assistant sales manager of the New York district to sales manager of the district. Dietz has represented the company on the east coast since 1954.

Hendrick Manufacturing Co. has announced the appointment of three new sales offices. They are **Filters Inc.,** for New England, **Frank W. Lynch & Co.,** for Michigan, and **Harold Snedeker** for northern New York state.

Denver Equipment Co. has announced the appointment of **H. J. Gisler,** as manager of the Eastern Sales Division. For the past 15 years Gisler has been chief metallurgist of the company.

Richard W. Flagg, who has served as assistant director of the Denver Ore Testing Division for **Denver Equipment Co.,** has been promoted to chief metallurgist.

James E. Sheets has been named eastern sales manager for **LeTourneau-Westinghouse Co.** He will be in charge of operations for the company's Eastern Sales Division which includes 22 states and five Canadian provinces.

D. B. Oldaker and **W. C. Sullivan,** both of the Saint Louis engineering department of **Monsanto Chemical Company's Inorganic Chemical Division** have been appointed to new positions at the division's new ultra-pure silicon plant now under construction near St. Charles, Mo.

Sullivan, who has been with the division's engineering department since 1953 will be engineering supervisor, and Oldaker who has been in the division since 1952 will become maintenance superintendent.

Charles J. Lloyd has been named sales engineer for mining and aggregate screens by **Cross Perforated Metals** of **National-Standard Co.** Lloyd had been a sales engineer with Fairmont Machinery Co. for seven years.

CATALOGS & BULLETINS

MINE MORE. *Caterpillar Tractor Co., Advertising Div., Peoria, Ill.* Booklet No. D933 gives information pertinent to increasing output and profits on mining jobs by describing the use of Caterpillar equipment in land clearing, overburden removal, mineral excavation, and hauling and stockpiling. Citing actual case histories, the booklet shows crawler- and wheel-type tractors, motor graders and diesel engines engaged in various mining applications.

PORTABLE SILICON RECTIFIER FOR MINES. *General Electric Co., Schenectady 5, N. Y.* GEA 6977 describes the Lo-Boy, a unit in which the rectifier and transformer cars are mounted on wheels for use on rails, and have no moving parts except for fans used to cool silicon diodes. Protective relays, designed for unattended operation, guard against internal damage of the equipment and the distribution system.

HELICAL GEAR SPEED REDUCERS. *Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.* All of Link-Belt's line of In-Line helical gear speed reducers are included in a single catalog called Book 2751. Information is included on 20 reducer sizes in double, triple, and quadruple reductions. Descriptive data is given on horsepower and torque ratings, dimensions, overhung load for high and low speed shafts plus mounting arrangements and a resume of construction features. Also mentioned is selection information on motor couplings and geared flexible couplings designed for these reducers.

HYDRAULIC HOSE AND ASSEMBLIES ON MINING EQUIPMENT. *Hydraulics Inc., 40 Lafayette St., Newark 2, N. J.* This 16-page every day guide outlines low to high pressure hose specifications and includes detailed thread and fitting information for both permanent and re-usable types of couplings. The catalog is available by request upon company letterhead.

AIR SAMPLER. *The Staplex Co., Air Sampler Div., 777 Fifth Ave., Brooklyn 32, N. Y.* Brochure IH-4 provides detailed information concerning the Staplex Hi Volume Air Sampler, an air monitoring device which detects and measures airborne particulate matter considered hazardous to personnel.

10-YD DUMPTOR BULLETIN. *Koehring Division of Koehring Co., Milwaukee 6, Wis.* Bulletin K-618 features the model 100 Dumptor, a 10-yd capacity off-the-road hauling unit and portrays it through the use of on-the-job views, component parts blow-ups, and drawings illustrating and describing the machine's two-way controls and its instantaneous gravity and controlled gravity dumps.

CHEMICALS. *The Dow Chemical Co., Midland, Mich.* Dow 1959–60 general catalog lists some 375 industrial, pharmaceutical, and agricultural chemicals currently being produced. The new edition also includes an expanded section on plastics and coating products.

DRILLS AND DRILL EQUIPMENT. *Atlas Copco Eastern, 610 Industrial Ave., Paramas, N. J. and Atlas Copco Pacific, 930 Brittan Ave., San Carlos, Calif.* Two new folders available are E-431 describing Sandvik Coromant 1½ in. extension drill equipment and E-1155 which portrays many of the applications of the lightweight Cobra motor drill and breaker. The Cobra is illustrated in action and the 53-lb gasoline-powered unit is depicted clearly by cutaway drawings.

ROTARY PADDLE FEEDER. *Richardson Scale Co., Van Houten Ave., Clifton, N. J.* Illustrated with photographs and an isometric drawing, Product Data Sheet No. 5901 describes a rotary paddle feeder designed to eliminate "pile-up" or packing in the flow of non-flushy ground and small-size granular materials. The feeder includes in-line feed and discharge and can be installed directly below bin, spout or storage hopper to save floor space. It is available in two sizes.

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HIGH CAPACITY FEEDER FOR DRY MATERIALS. *B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R. I.* The Omega Hi-Weigh Belt Gravimetric Feeder which continuously weighs and feeds dry materials is the subject of B-I-F Bulletin 35.20-2. Among the many features of this equipment discussed in this folder is the patented Sens-A-Gram, a sensitive mechanical controller which is shown in a cutaway view. Also included are photographs of installation procedures, dimensional drawings, and a list of accessories.

CONSTRUCTION SERVICES. *Panellit Service Corp., Div. of Panellit, Inc., 7401 N. Hamlin Ave., Skokie, Ill.* Bulletin 107 gives a complete descriptive and illustrative treatment to the company's installation through start-up service for automation and instrumentation systems. Services include a contract organization furnishing installation drawings and installation of the panels, field instruments, field interconnections, commissioning, operator orientation and providing supplementary instrumentation personnel where needed.

CRAWLER-MOUNTED FRONT-END LOADER. *Koehring Div., Koehring Co., Milwaukee 16, Wis.* The Model 205 "Skooper", a full-revolving front-end loader, is described in Koehring's Bulletin K-636. Illustrations and captions point out various mechanical features and a series of on-the-job pictures shows the machine at work in mining, stockpiling and other industrial operations.

DENSITY MEASUREMENT AND CONTROL GAGE. *The Ohmart Corp., 2236 Bogen St., Cincinnati 3, Ohio.* Bulletin ASR-3 gives specification data and performance advantages of the Ohmart density and measurement control gage for use on pipes up to three in. in diam. Gage is bolted into slurry or liquid line and makes continuous measurements of the specific gravity of the material flowing through the pipe. Control signals may actuate valves, pumps, alarms, etc., and with a recorder provide an accurate record of through-put density.

COMPRESSED AIR FUNDAMENTALS. *Ingersoll-Rand Co., 11 Broadway, New York, N.Y.* This booklet describes basically compressed air, how it is compressed, single- and two-stage compressors, piston displacement, actual delivery, unloading of compressors, regulation and types of control used. Other material included is information on compressor oils, pipe sizes, wire sizes, and terminology and definitions used in connection with compression of air, as well as tabular and chart information on this subject.

OPTICAL EQUIPMENT. *Keuffel & Esser Co., Adams and Third Sts., Hoboken, N. J.* "Optical Tooling and Industrial Alignment Equipment" is the name of a new catalog issued by K&E covering a complete line of jig transits, alignment telescopes, collimators, instrument testing equipment, lamp housings, scales, tapes, targets, mirrors and other equipment. This catalog also carries an account of the development of optical tooling and alignment equipment at K&E.

SELF-PROPELLED BANTAM. *Schield Bantam Co., Waverly, Iowa.* Bulletin CR-350 describes and illustrates the Model CR-350, 11-ton crane-excavator, including a complete line of front-end attachments. Shown and discussed are such features as the heavy duty drum shaft and swing assembly; heavy duty turntable design, three types of boom hoists; automotive type steering, 4 x 2 and 4 x 4 drive plus others. Also mentioned are the many applications of the equipment.

HYDRAULIC RESCUE EQUIPMENT. *The Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.* Operating principles of this Port Power equipment are described in Bulletin No. 0911-1 which, with Parts List No. 0911-2, also give a wide variety of application illustrations. Three packaged set are covered in the bulletin: four ton for light duty; ten-ton for general duty; and 10- and 20-ton for heavy duty. There is also a special 50-ton unit for lifting in mine and other industrial disasters.

ENGINEERING DATA SHEET — HORSEPOWER NOMOGRAM. *Merkle-Korff Gear Co., 213 N. Morgan, Chicago 7, Ill.* Entitled "Horsepower Nomogram for Motors and Transmissions", this dual Nomogram for Horsepower, Torque and RPM is applicable to fractional horsepower motors and transmissions and gives two scales each for horsepower and for torque. It is issued in handy data sheet form, 8½ × 11, and three hole punched. Scales as follows: RPM from 0.5 to 500; torque to 300 in.-lb on one scale and 600 ft-lb on the others; horsepower for corresponding product values of torque and rpm.

Index to Advertisers

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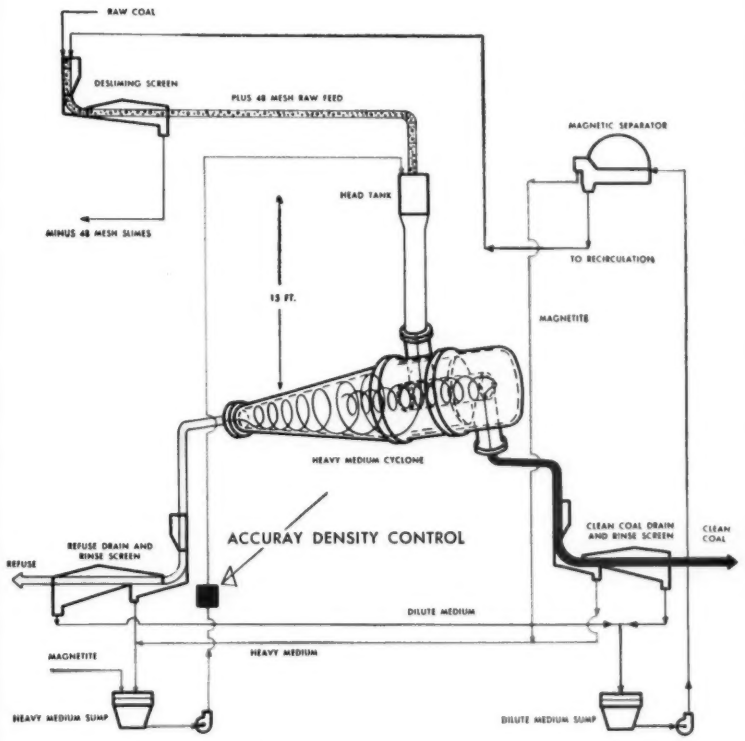

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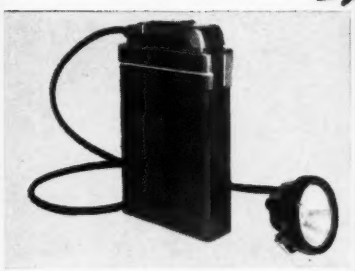

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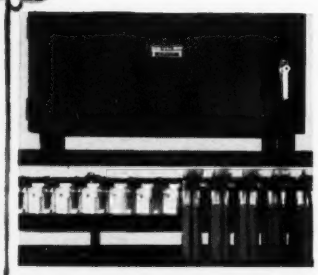

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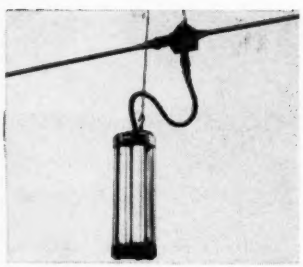

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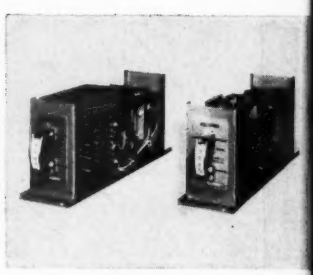

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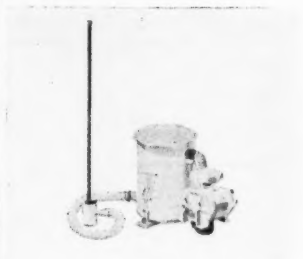

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